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COMPARISON OF ALTERNATIVE CRITERIA AND WEIGHTING METHODS FOR THE ENLISTED ADVANCEMENT SYSTEM

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13 ABSTRACT

The Navy Enlisted Advancement System is based on several components which are differentially weighted in arriving at a final ordered listing of the candidates. The components used--technical knowledge exam, on-job performance marks, time in grade and in the Navy, and awards--vary greatly in their statistical properties, and thus the task of combining them in accordance with the policy-designated weights becomes complicated and difficult. The outcome of the advancement process--that is, the actual selection of those to be advanced--has been found to be more a function of the statistical peculiarities of the components used and of the methods used in combining them, than of published policy. This report describes a comparison of several approaches to combining scores and weighting components used in the advancement competition to Pay Grades E4-E7. The qualifications of candidates who were selected, and who would have been selected had other cutting scores and weighting methods been used, were compared.

The proportionate influences of the components were found to vary widely as a function of advancement opportunity, cutting scores used, and pay grade.

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SUMMARY

A. Problem and Background

The Navy Enlisted Advancement System is based on several components which are differentially weighted in arriving at a final ordered listing of the candidates. The components used--technical knowledge exam, on-job performance marks, time in grade and in the Navy, and awards--vary greatly in their statistical properties, and thus the task of combining them in accordance with the policy-designated weights becomes complicated and difficult. The outcome of the advancement process--that is, the actual selection of those to be advanced--has been found to be more a function of the statistical peculiarities of the components used and of the methods used in combining them, than of published policy.

B. Approach

This report describes a comparison of several approaches to combining scores and weighting components used in the advancement competition to Pay Grades E4-E7. The qualifications of candidates who were selected, and who would have been selected had other cutting scores and weighting methods been used, were compared. The investigation represents an attempt to understand the problems inherent in the system and to develop procedures to increase the likelihood that the advancement system will consistently select those individuals most deserving of advancement. Because of its influence upon morale, the policy of granting "bonus points" to candidates who pass the exam but are not advanced (PNA) was in particular addressed.

C. Findings and Recommendations

The proportionate influences of the components were found to vary widely as a function of advancement opportunity, cutting scores used, and pay grade.

Short-term recommendations for improving the present system were made on the basis of the present analysis. However, basic long-range improvement in the system must await the findings of research on the differential relevance of the various components to future performance, and the development of responsive iterative computer programs, for weighting the advancement factors in accordance with policy.

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CONTENTS

TABLES

TABLES (continued)

FIGURES

COMPARISON OF ALTERNATIVE CRITERIA AND WEIGHTING METHODS FOR THE ENLISTED ADVANCEMENT SYSTEM

A. STATEMENT OF THE PROBLEM

1. Background

The Enlisted Advancement System is a vitally important personnel management function which the Navy desires to improve in order to enhance morale in general and retention in particular. Prior to implementing changes designed to effect such improvement, research must be done to:

a. Identify some of the alternative courses of action which might be considered,

b. Develop analytical methodologies appropriate for investigating the courses of action, and

c. Determine the outcome of each alternative.

A number of factors are considered in Navy advancement selections, and these are differentially weighted in an advancement composite, the Final Multiple Score (FMS). It has long been recognized (e.g., the SECNAV Task Force on Retention, 1966) that the appropriateness and weighting of the factors comprising this advancement multiple have an important bearing on the morale of enlisted personnel.

A particularly crucial aspect of the advancement problem as it relates to retention is the disappointment experienced by nonadvanced personnel who pass the advancement exam but are not advanced because of quota limitations (i.e., Passed but Not Advanced--PNA). In recognition of this situation, which is prevalent in competition to the higher pay grades, it has sometimes been recommended that "bonus points" be added to an individual's Final Multiple Score for each time the candidate passes an examination but is "PNA'd" (e.g., Item 58 of the Career Motivation Conference of 1969).

2. Purpose

This report presents comparisons among alternative analytical techniques, as well as alternative weighting designs. An additional interest is also to identify possible actions for short-term relief of specific problems, pending further progress on long-term developments. Accordingly, this report is addressed to the following problems:

a. How useful are the various available methodologies for analyzing the system and demonstrating outcomes?

b. What is the incidence of PNA and exam-fail in different Ratings and pay grades?

c. What outcomes derive from the alternative weighting procedures?

d. What short-term possibilities warrant exploration as means of improving the Enlisted Advancement System, pending the development of long-term solutions?

B. PROCEDURES

1. Data

The factors in the advancement multiple include a written exam score, on-job performance evaluation marks, time in the Navy, time in pay grade and medals and awards. Data comprising such factors were provided by the Naval Examining Center, Great Lakes, for several samples of candidates:

a. From the group of candidates who competed for advancement in February 1967 (Exam Series 42), a period of relatively high active duty force levels, the following representative Ratings were selected for analysis (See Appendix B for complete titles):

Pay Grade	Ratings
4, 5, 6, 7	ADR, AK, AX, CS, DC, ET, FT, HM, PN, RM, ST, TM

b. For a period shortly after a substantial reduction in force level, August 1969 (Exam Series 51), the following representative Ratings were selected:

Pay Grade	Ratings
4	ABH, AX, HM, PN
5	ABH, ADJ, AX, FT, HM, PN, SD
6	ABH, ADJ, AT, AX, FT, HM, MN, PN, RM, SD, TM
7	ABH, ADJ, AT, AX, EM, FT, HM, MM, MN, PN, RM, SD, TM

In order to construct a pass-fail history, data for all advancement candidates were utilized for the above Ratings for all exam series in calendar years '67, '68 and '69. These data included two series per year to Pay Grades 5, 6 and 7; and four series to Pay Grade 4 in 1969. Ratings selected for analysis were those which varied widely in advancement opportunity and PNA incidence.

c. Since the Series 51 data were the most recent available at the time of commencing the analysis, in order to make the study relevant to current conditions, Series 55 (August 1970) decisions were simulated by applying Series 55 advancement quotas and exam cutting scores to the Series 51 data.

2. Alternatives Investigated

For advancement to E-4/5/6/7, six components are weighted as indicated in Table 1 (see Appendix A for all Tables and Figures). The composites, i.e., Final Multiple Score (FMS), of competing candidates are rank-ordered within each Rate (i.e., within technical specialty and pay grade). Advancements are effected from the top of the rank-ordered list of composite scores. However, candidates failing to score above a certain cut-off point on the examination are not considered further irrespective of their FMS. These cutting scores vary widely, from as low as the 4th percentile in Pay Grade 4 in some Ratings, to as high as the 66th percentile in Pay Grade 7 in other Ratings. There are thus three possible outcomes--Fail the examination (F), Pass the examination and be Advanced (A), and Pass the examination but Not be Advanced (PNA). The outcomes from five alternative weighting designs (the operational design and four experimental variations) are presented in this report:

a. Operational - for Series 42, 51, and simulated 55 data (Method 1).

b. Experimental - for a few representative Ratings of each pay grade from simulated Series 55 data, present operational procedures (Method 1) were modified as follows: (Components are the same as those indicated in Table 1, although Good Conduct Medals and Other Awards are combined in one "Awards" (AWD) component. NC indicates No Change. The new component, PNA, represents two points per previous PNA.)

Method	Alternative	Maximum Points			
		PNA	TIR	LOS	FMS
1	Operational	--	20	20	185
2	PNA (20)	20	NC	NC	205
3	PNA (TIR 10)	10	10	NC	NC
4	PNA (LOS 10)	10	NC	10	NC
5	LOWCUTS - No Change from points indicated in Table 1, but lower cutting scores (see Table 2) than present operational procedures.				

c. For an indication of what enlisted personnel think the proportionate influences are and should be, two unstructured and five structured items were designed (see Appendix C) and administered to a small sample of personnel in Pay Grades 4-7.

d. With the exception of the PNA Bonus, only components presently in the Advancement Multiple (FMS) were investigated.

3. Analysis

a. Criterion. Using multiple regression analysis, $r\beta$ products were computed as the measure of proportionate influence for each

component. Employing the methodology discussed in Appendix D and demonstrated in Table 3, the dichotomous criterion of Advanced-Not Advanced was compared with the composite score (FMS).

b. Longitudinal Incidence of PNA and Exam-Fail. Taking the most recent set of advancement data as the base (Series 51) the number of candidates in each Rate group who PNA'd or failed the exam once, twice, etc., up to six times, in the previous three years, was tallied.

c. Comparison of Selectees. Characteristics of candidates selected by each alternative method were computed for two categories of selected candidates:

(1) For the candidates selected uniquely (i.e., not the entire advanced group) the mean of each component was obtained for each experimental procedure and compared with the mean for the operational procedure.

(2) The proportion of the entire advanced group drawn from each quarter of each component was analyzed by a computer program, the Tetra Summary, developed for this purpose. Each component was independently rank-ordered, partitioned into quarters, and the proportion advanced from each quarter tallied.

Only a few representative Ratings of each pay grade, those with PNA in Series 51, were included in the in-depth analyses described above. These were:

Pay Grade	Ratings
4	ABH, PN
5	ABH, FTG, PN
6	ABH, AT, FTG, PN
7	ABH, AT, FTG, PN

d. Survey Analysis. Means, standard deviations, and frequency distributions were computed for the items on the questionnaire, Appendix C, asking what the proportionate influences should be.

C. RESULTS

1. Previous PNA and Fails

As indicated in Table 4, the incidence of previous Fails is much greater than of previous PNA. The highest incidence of both (excluding the Petty Officer third class Rates, in which advancement opportunity is seldom restricted and exams are sometimes administered quarterly) is for competition to ABHC, in which 24 percent of the

candidates had one or two previous PNA, and 42 percent had one or two previous Fails. Generally, it may also be noted that:

a. Many candidates have five or more Fails.

b. Few candidates have more than three PNA, and

c. Incidence of Fails is fairly consistently high across Ratings as compared with PNA's, which vary from zero to many, depending upon advancement opportunity.

2. Proportionate Influences of Components

a. Table 5a permits a comparison of the effective (as defined in Appendix D and distinguished from nominal) proportionate weights of the components when applying a dichotomous (Advanced-Not Advanced) and a continuous (FMS) criterion variable. As stated above, the February 1967 data reflect a period of relatively high active duty force levels. It may be noted that:

(1) Considering the median weights of the above two types of variables on the first two components indicated in Table 5a,

	EXAM		PERF	
Percent PNA	A/NA	FMS	A/NA	FMS
None	99	67	0	23
1-10	99.5	63.5	1.5	23
More than 11	96	61	3	19

when the dichotomous criterion (A/NA) is applied, it indicates that the exam is virtually the sole determinant of advancement, especially with few or no PNA; while the continuous criterion (FMS) permits the exam to contribute much less weight.

(2) If all of those passing an exam are advanced, and all of those failing the exam are not advanced (i.e., no PNA), the exam obviously must be the sole determinant of advancement. Yet, the range of exam weights in Table 5a, applying the FMS as the criterion variable, for the 19 Rate groups with no PNA, is noticeably less than 100 percent weight, i.e., 42-77 percent.

(3) Some of the weights are slightly negative or in excess of 100 percent, for the reasons stated in Appendix D.

b. The Rate groups in Table 5b, from data which reflect a period (1969-1970) after substantial reduction in force levels, are arranged by pay grade, rather than by PNA incidence as in Table 5a. (The reason for the pay grade grouping was to avoid an implication of a

higher-than-actual PNA base rate among Rate groups, since many high-PNA Rates had intentionally been selected for the purpose of studying that particular problem.) Table 6 presents the range and median of the simulated August 1970 weights from Table 5b. It may be noted that:

(1) Again, the exam weights, applying the continuous (FMS) criterion, are noticeably lower than when applying the dichotomous criterion.

(2) On each component, there are extreme differences in weights across both Rating and pay grade groups.

(3) Although the simulated Series 55 data indicate slightly less dominance by the exam component than the Series 42 data (in part because of the intentional selection of high PNA Rates), the exam still accounts for greater than 90 percent of the weight in: Two of the four Pay Grade 4 Ratings, five of eight Pay Grade 5, four of thirteen Pay Grade 6, and five of fifteen Pay Grade 7 Ratings.

3. Expressed Preference for Proportionate Weights

a. Figures 1-6 display the distribution of responses to Questions 1-7, Appendix C. Questions 1 and 2 (what the proportionate influences actually are and should be, Figures 1 and 2, respectively) were open-ended. The enlisted respondents could express their opinion by entering any combination of values totaling 100 percent. There was fairly close agreement among all pay grades both on "actual" and "should be" opinions. Generally, however, the respondents indicated that exam and experience should be reduced slightly, and performance increased slightly over what they thought the weights actually were. Taking the Pay Grade 7 "should be" responses as an approximate median, the proportions are:

EXAM	PERF	LOS	TIR	Good Cond.	Other AWD	Any Other
54	26	5	6	3	2	2

b. Questions 3-7 were structured to investigate the differential preference for a wide variety of sets of proportionate influences. Generally, those combinations high on performance, both on technical knowledge (as measured by the exam) and on-job (as measured by evaluation marks), were considered the fairest. As Figure 3 indicates, the combinations presented in Questions 5, 7 and 4 were considered the fairest; Questions 6 and 3, the least fair.

c. Although there was close agreement on the mean fairness among all four pay grades, there was substantial disagreement on the degree of fairness within pay grade. The highest (i.e., modal) frequency of

a particular degree of fairness, Questions 3-7 on Figure 4, was only 40 percent (for Question 5). Consider, for example, the distribution of fairness responses for Question 4, in which the modal response of 29 percent is c--"slightly fair." However, the "unfair" responses (d, e and f) total 45 percent.

d. Figure 5 displays the distribution of fairness responses by pay grade for Question 5, which was highest among Questions 3-7 on fairness, and which also most closely approximates the intended component weights as represented to the Fleet (Table 1).

4. Effect of Alternative Weighting Procedures

a. In analyzing the outcomes of the five alternative methods (as defined in above paragraphs B.2.a. and b.), it is useful to consider each Rate group as falling within one of four PNA categories. The thirteen Rate groups (a few from each pay grade) selected for this part of the analysis were categorized as follows:

Percentage of Candidates with Incidence of PNA

		Present PNA: High (17-38%)	Present PNA: Low (0-6%)
Incidence of Previous PNA's: High (6-35%)		PN1, ABHC, PNC, ATC	ABH3, PN3, PN2
Incidence of Previous PNA's: Low (0-1%)		ABH1, FTGC	ABH2, FTG2, FTG1, AT1

Another consideration is the existence of a skewed distribution on any component to which a new maximum or minimum is imposed by an alternative method which appreciably curtails the distribution. For example, the 10-point maximum PNA bonus of Method 3 affects no Rate group, since there are virtually no cases of more than four previous PNA. However, some Rates have a substantial pile-up of TIR points so that the TIR maximum of 10 points of Method 3 makes a substantial difference.

b. Given the above considerations, the following observations may be made from Table 7:

(1) Regardless of previous PNA, with little or no present PNA, the PNA Bonus Methods (2, 3 and 4) have little or no effect which is different from the operational method (e.g., ABH3, PN3, ABH2, FTG2, PN2, AT1, and FTG1).

(2) With a high present PNA, but little or no previous PNA, there is little difference in effect (e.g., FTGC), unless the distribution of a component is so high that it is substantially curtailed by a newly imposed maximum (e.g., for ABH1, no PNA effect, but lower LOS by Method 4).

(3) With both present and previous high PNA, the PNA bonus methods generally increase the exam influence (from the combined weights of the exam component and the PNA component, e.g., applying Method 3 to ABHC, 84.9 + 9.6); lower LOS, TIR and Awards; and do not change the performance component (e.g., PN1, ABHC, ATC, and PNC).

(4) Although there are some exceptions, reducing the exam cut-scores (Method 5) generally decreases the exam weight and increases the other component weights (e.g., ABH2, FTG2, PN2, AT1 and FTG1). The changes are less extensive and more variable in those Rate groups with a present high PNA, because the exam cut-score is not at the advancement opportunity, thereby enabling the other components to contribute some weight.

c. Since the primary interest in the direction and extent of change in weights by alternative methods should be in relation to some objective, Table 8 was constructed by applying the data of Table 7 to a specific criterion. (As stated in Table 8, the criterion used was an approximation of the weights favored by the enlisted respondents to the Questionnaire in Appendix C.) In terms of convergence towards, or divergence from the criterion, Table 8 Method Summaries indicate, from the:

(1) PNA bonus methods, divergence on LOS, and for Method 4 only, convergence on performance. (However, when the PNA bonus is considered as part of the exam component, the combined effect is a slight divergence.)

(2) Lower Cuts method, convergence on exam and performance, and divergence on TIR.

All other effects were slight or variable. As stated above, the extent of the effect is dependent upon the incidence of present PNA--decreasing the relative effect of the Lower Cuts method; and increasing (if also previous PNA) the PNA bonus effect.

d. Would different candidates actually be selected by one weighting method in lieu of another? If so, to what extent? And what are the qualitative differences between those uniquely selected and the other candidates consequently not selected (i.e., "bumped")?

(1) From Table 9, it is evident that the PNA bonus methods could select substantial proportions of the advanced group uniquely different from the present operational method (e.g., 8-57 percent), dependent upon both present and previous high PNA (PN1, ABHC, ATC and

PNC). (Thus, since ABH2, FTG2, FTG1, FTGC and AT1 had only one or no previous PNA's, the PNA bonus points had no effect.) Although the proportion of uniquely selected candidates is large for some methods, the number of candidates is usually small because of the extremely restricted advancement opportunity. By the Lower Cuts method, the lower the present or previous PNA incidence, the greater is the proportion of unique selections (e.g., AT1 and FTGC).

(2) The qualitative mean differences[1] presented in Table 10 generally reflect the same shifts as indicated in Table 8.[2] Considering again the PNA categories of above paragraph C.4.a., when candidates are uniquely selected by a given experimental method, it may be observed that:

(a) With present low PNA, regardless of previous PNA (Rate groups PN2, ABH2, FTG2, FTG1 and AT1), only Method 5 (Low Cuts) resulted in usually significant differences of lower exam score, better on-job performance and awards, and greater experience (LOS and TIR). (The only Rate groups without differences, ABH3 and PN3, had very high advancement opportunity, 90 and 94 percent respectively. Thus, cut-scores were already nearly as low as the experimental Method 5 cuts, and no candidates were uniquely selected.)

(b) Combining Rates with both present and previous high PNA (PN1, PNC, ABHC, ATC):

i. Method 2 had no significant effect.

ii. Methods 3 and 4 raised exam and performance means (Method 4 only) and lowered LOS, TIR and Awards.

iii. Method 5 results were similar to the above low PNA groups, but differences in performance were not quite significant ($p < .06$).

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[1] In analyzing qualitative differences among only the uniquely selected candidates, especially in the Rates with extremely limited advancement opportunity, the very small N's pose a severe problem for significance tests. Is each Rate group to be viewed as a total population or as a sample of a recurring situation over several advancement competitions? Some arguments which support the population view are: The present data set comprise a PNA history extending over several exam series and years; and advancement opportunity and force levels vary over time. Thus the combining of total Rate groups across exam series may not be "samples" from the same population. (However, since one of the principal questions of interest in the present study is the nature of the PNA problem, some Rate groups with a common characteristic--a high incidence of both present and previous PNA, were combined in order to increase sample size, and are also presented in Table 10.) It would be no consolation to a few candidates (but who comprise a substantial proportion of the advanced group) to be advised that the differences between their qualifications (herein component scores) and those of a few others selected in lieu of them by an alternative method, were large but not statistically significant. Thus the data presented for small N's, if not supportive are certainly strongly suggestive of differential effects from alternative weighting systems.

[2] As stated in Note a of Table 10, the means were computed from the actual component values (i.e., to reflect the actual characteristics of the candidates), although the maximum cut-offs were applied in making the selections. For example, applying Method 3 to the ATC Rate, which resulted in three unique selections, the mean TIR of the three "bumped" candidates--123.66, was computed from scores of 126, 149 and 96. However, the selections by Methods 1, 2, 4 and 5 were based on scores of 120, 120 and 96 respectively; and by Method 3, of 60, 60 and 60.

5. Discussion

a. Although the above comparison of uniquely selected candidates provides useful insights concerning differences among alternative weighting methods, the ultimate concern is with the qualitative characteristics of the total groups selected by a particular method. Table 11 presents a sample of the computer-generated Tetra Summary. Table 12 shows the proportion advanced within each quarter for the thirteen Rate groups studied.

b. Presumably, a multi-component system should select the "best performers," in terms of technical knowledge and on-job behavior, from the high end of each appreciably weighted component. This would be reflected by consistent decreases in proportions advanced from the upper through the lower segments of each component's distribution. Table 12 indicates this always to be the case, by Method 1, for the exam component, but seldom the case, for performance. Some quarter other than the top quarter of on-job performance usually contains the highest proportion of advancements. In one case, the bottom quarter (FTG1); in another case, all other quarters are higher than the top quarter (AT1).

c. Figures 7 and 8 display the resulting shifts in slope from the alternative weighting methods for cases representative of various PNA incidence. It may be noted that:

(1) The higher the present PNA, the more the other components (besides exam) tend towards a downward slope, and the less relative shift in slope from Method 5 (Lower Cuts).

(2) If low present or previous PNA, no shift results from any PNA bonus (Method 2, 3 or 4).

(3) If no present PNA, ascending slopes can occur on other than exam components, as is strikingly the case with AT1. Lower exam cuts reverse the slope.

D. SUMMARY OF FINDINGS

The relevancy of alternative methods for analyzing the Enlisted Advancement System were investigated. The outcomes from five alternative weighting systems as applied to the components in the advancement composite were also demonstrated.

1. The outcomes from a dichotomous (advanced vs. not advanced) and a continuous (FMS) dependent variable were compared, using multiple-regression analysis. The dichotomous criterion was found to be the more relevant, because a continuous criterion is not sensitive to the influence of component cut-off scores and advancement quotas.

2. When wide fluctuations in component distributions occur across and within pay grades and Ratings, they produce similar wide fluctuations in the effective (as defined in Appendix D) weights of the components.

3. Differences in exam cut-off points and advancement quotas (also across pay grades and Ratings) cause the proximity of cut score to selection opportunity to have a substantial and varying influence on advancement. There is a much greater incidence of exam-fail than PNA. Thus it is the paucity, rather than the high prevalence, of PNA which poses the greater problem.

4. A newly developed nonparametric method, the Tetra Summary, was found to be very useful in comparing the quality levels among components for the advanced group.

5. Enlisted personnel indicate a preference for proportionate weights of the components fairly close to the published weights.

6. Alternative weighting systems of:

a. PNA bonus points

(1) Increase further the exam weight at the expense of LOS and TIR.

(2) Select about 25 to 50 percent of the advanced candidates uniquely different from the operational system, only if there exists for that Rate group a high incidence of both present and previous PNA.

b. Lower exam cut-points achieve effective component weights which tend toward the nominal (i.e., the intended or policy) weights, thereby decreasing the exam weight and raising the weights of other components.

E. RECOMMENDATIONS

1. Short-Term Recommendations

a. If it is desired that effective weights more closely approximate nominal weights, apply lower exam cut-scores for competition to Pay Grades 5, 6 and 7.

b. If it is desired to reward previous high exam scores only, with the present system otherwise continuing to function the same,

(1) Apply the PNA bonus as an addition to the composite (FMS), i.e., Method 2, although a maximum of 10 points, vice 20 points, would suffice.

(2) Do not apply a PNA bonus in lieu of TIR or LOS, since this could increase exam weight and reduce LOS and TIR weight even in cases of no previous PNA incidence.

2. Long-Term Recommendations

The purpose of this Technical Bulletin was limited to the demonstration of outcomes from comparison of alternative weighting and analytical methods. No major changes to the present operational system are recommended at this time. Prior to making such recommendations, research is needed to:

a. Determine the differential relevance (across Ratings and pay grades) of the various performance factors (on-job, technical knowledge, and awards) to qualifications for the next higher Rate and to retention.

b. Develop an adaptive advancement system, employing iterative computer programs capable of achieving policy weights given substantial fluctuations in component distributions and advancement opportunity, both among and within pay grades and Ratings.

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APPENDICES

APPENDIX A

Tables and Figures

TABLE 1

Components and Maximum/Minimum Points in the Final Multiple Score for Advancement in Rating to Pay Grades E-4/5/6/7

Component	Maximum Points	Maximum as Percentage of Composite (FMS)	Multiplier	Minimum Points
Examination Score	80	43.3	1	Varies[a]
Performance Evaluations	50	27.0	30P-70	(None)
Length of Service (LOS)	20	10.8	$\frac{1 \times \text{Months}}{12}$	(None)
Service in Pay Grade (Time in Rate--TIR)	20	10.8	$\frac{2 \times \text{Months}}{12}$	(None)
Good Conduct Medals	10	5.4	1	(None)
Other Awards	5	2.7	1	(None)
Final Multiple Score (FMS)	185	100.0		

Note.--Weighting factors listed are "nominal"--or intended weights. In actual practice the effects of the cuts used yield results highly discrepant from those desired. See text for discussion.

[a]Minimum (i.e., "cutting-score") varies by pay grade from standardized "T" scores ($\bar{X}$ = 50, SD = 10) of 32 for some E-4 Ratings, to 54 for some E-7 Ratings. See Table 2.

TABLE 2

Advancement Opportunity and Exam Cut Point by Pay Grade for Two Operational (Series 42 and 55), and One Hypothetical Advancement Series

Pay Grade	February 1967 (Series 42)				August 1970 (Series 55)				Hypothetical[a]		
	Exam Cut T-Score	Range % Pass	% Advancement Opportunity Range	Mdn	Exam Cut T-Score	Range % Pass	% Advancement Opportunity Range	Mdn	Exam Cut T-Score	Range % Pass	% Pass Minus Advancement Opportunity (i.e., PNA)
4	32-47	62-96	33-97	91	32	96	90-96	92	32	96	4
	Representative Ratings: 17					4					
5	44-50	50-73	29-76	54	44-50	50-73	64-75 (less SD=5)[b]	71	41	82	11
	Representative Ratings: 17					9					
6	52	42	4-45	27	50-52	42-50	4-50	9	47	62	53
	Representative Ratings: 12					14					
7	54	34	6-40	12½	50-54	34-50	3-22 (less MN=44)[c]	5	49	54	49
	Representative Ratings: 12					16					

[a] This is Method 5 as described in paragraph B.2.b.

[b] Excludes extremely atypical case of SD2 of 5 percent advancement opportunity.

[c] Excludes extremely atypical case of MNC of 44 percent advancement opportunity.

TABLE 3

Intercorrelations and Correlation-Beta Weight Products of Advancement Components For the Personnelman (PN) Rating, Pay Grades E-4/5/6/7 (Series 51)

		EXAM	PERF	LOS	TIR	AWD	FMS	A/NA	EXAM	PERF	LOS	TIR	AWD	FMS	A/NA
	EXAM		216	-128	-068	012	905	796		160	-144	-153	-103	869	645
	PERF			-084	-027	034	575	386			-105	-181	-065	471	218
r	LOS	To PG 4			784	304	-030	-095	To PG 5			677	607	162	039
	TIR	N = 589				241	062	-010	N = 911				478	126	-009
	AWD						099	011						160	087
							R^a	R^2						R^a	R^2
$r\beta^b$	FMS	748	229	-	007	-005	994	989	753	182	023	023	010	998	997
	A/NA	596	086	004	-001	-	828	685	417	029	003	-	010	677	458
	Adj/A[c]	870	126	006	-002	-			911	063	007	-	022		
	EXAM		142	-141	-007	-142	680	185		094	-272	049	-209	741	223
	PERF			-121	-032	-030	405	053			-145	-007	092	368	072
r	LOS	To PG 6			700	775	475	248	To PG 7			547	703	245	077
	TIR	N = 519				649	581	372	N = 498[d]				437	489	119
	AWD						469	185						328	097
							R^a	R^2						R^a	R^2
$r\beta^b$	FMS	474	144	132	168	083	999	999	608	112	048	169	060	998	996
	A/NA	033	003	025	139	-020	424	180	057	004	005	007	006	283	080
	Adj/A[c]	183	017	139	772	-111			709	047	069	094	081		

Note.--Decimal points for correlations have been omitted.

[a] R--Multiple correlation coefficient.

[b] rβ--Product of the component's correlation with the composite and beta weight.

[c] Adjusted A/NA rβ's proportionately to total 1000.

[d] Does not include candidates for Warrant Officer program.

TABLE 4

Incidence of Previous PNA and Exam-Fail of Series 51 (August 1969) Candidates During Calendar Years 1967-1969 Series

Series 51 Candidates			Frequency of Previous:									
			PNA				Exam-Fail					First Try
Rate		Total	1	2	3	4 or more	1	2	3	4	5 or more	
ABH3	N	418	113	33	5	-	105	55	22	8	1	136
	%		27	8	1	-	25	13	5	2	0.2	33
PN3	N	605	119	46	-	-	154	80	17	5	5	221
	%	-	20	8	-	-	25	13	3	1	1	37
ABH2	N	265	-	-	-	-	12	2	3	2	5	241
	%	-	-	-	-	-	5	1	1	1	2	91
FTG2	N	436	-	-	-	-	47	20	5	2	-	359
	%	-	-	-	-	-	11	5	1	0.5	-	82
PN2	N	911	189	2	-	-	211	63	17	9	-	448
	%	-	21	0.2	-	-	23	7	2	1	-	49
ABH1	N	176	2	-	-	-	34	24	14	10	10	83
	%	-	1	-	-	-	19	14	8	6	6	47
AT1	N	563	1	-	-	-	94	30	39	28	43	328
	%	-	0.2	-	-	-	17	5	7	5	8	58
FTG1	N	141	-	-	-	-	25	24	13	7	-	72
	%	-	-	-	-	-	18	17	9	5	-	51
PN1	N	519	23	9	-	-	101	48	23	36	49	258
	%	-	4	2	-	-	19	9	4	7	9	50
ABHC	N	230	45	9	2	-	59	37	26	10	15	60
	%	-	20	4	1	-	26	16	11	4	7	26
ATC	N	749	105	33	6	2	102	26	55	85	139	279
	%	-	14	4	1	0.3	14	3	7	11	19	37
FTGC	N	134	-	-	-	-	33	12	11	-	-	78
	%	-	-	-	-	-	25	9	8	-	-	58
PNC	N	626	78	21	10	1	155	66	61	46	117	156
	%	-	12	3	2	0.2	25	11	10	7	19	25

TABLE 5a

Comparison of a Dichotomous (Advanced-Not Advanced--A/NA) and a Continuous (Final Multiple Score--FMS) Criterion on Proportionate Influence of Components by Incidence of PNA (Series 42, February 1967, Data)

Rate	N	Advance/ PNA/Fail (% A/P/F)	Exam Score Cut Point	rβ Weights Component EXAM A/NA	EXAM FMS	PERF A/NA	PERF FMS	LOS A/NA	LOS FMS	TIR A/NA	TIR FMS	AWD A/NA	AWD FMS
	No PNA												
ADR3	703	92/00/08	32	100	70	--	24	--	2	--	3	--	1
CS3	1489	97/00/03	32	95	64	-1	34	3.5	1	1.5	1	1	0.5
CS2	1227	73/00/27	44	97	51	2	20	1	12	--	10	--	5
DC3	805	96/00/04	32	100	67	--	35	--	-1	--	-1	--	-
DC2	260	76/00/24	44	100	66	--	22	--	5	--	4	--	3
DC1	161	45/00/55	52	95	42	1	14	-2	15	--	17	6	11
ET3	642	90/00/10	32	100	77	--	22	--	0.2	--	0.4	--	--
ET2	1215	74/00/26	44	100	72	--	20	--	1	--	1	--	0.4
ET1	1001	45/00/55	52	100	59	--	15	--	8	--	8	--	5
ETC	419	38/00/62	54	99	50	--	15	--	9	--	13	1	9
FTG3	1162	92/00/08	32	96	76	4	24	--	-0.3	--	-0.2	--	0.2
RM3	690	96/00/04	32	100	70	--	29	--	0.3	--	1	--	-0.3
RM2	506	73/00/27	44	99	66	1	23	--	3	--	2	--	2
ST3	719	90/00/10	32	96	70	--	30	--	0.1	4	-0.5	--	0.2
ST2	693	74/00/26	44	99	76	1	20	--	1	--	2	--	0.4
ST1	254	45/00/55	52	98	53	2	34	--	2	--	7	--	4
STC	205	36/00/64	54	98	59	--	15	-2	6	2	9	2	10
TM3	536	94/00/06	32	100	73	--	28	--	-0.2	--	-1	--	--
TM2	659	52/00/48	50	98	69	2	23	--	2	--	3	--	2
	1-10% PNA												
ADR2	721	55/03/42	50	99	43	1	16	--	13	--	19	--	8
AK3	684	90/02/08	32	100	74	--	24	--	1	--	1	--	0.2
AK2	451	42/07/51	50	96	63	4	15	--	7	--	9	--	6
AKC	205	40/03/57	54	105	63	1	15	-5	3	--	14	-1	4
DCC	213	29/07/64	54	104	64	2	13	-2	5	-2	10	-2	8

(Continued on next page)

TABLE 5a (Continued)

Rate	N	Advance/ PNA/Fail (% A/P/F)	Exam Score Cut Point	rℓ Weights									
				Component									
				EXAM		PERF		LOS		TIR		AWD	
				A/NA	FMS	A/NA	FMS	A/NA	FMS	A/NA	FMS	A/NA	FMS
	1-10% PNA												
FTG2	1163	50/09/41	44	93	66	5	24	-2	3	4	3	--	3
FTG1	317	34/09/57	52	102	47	-1	22	-4	11	2	11	1	8
HM3	1724	57/05/38	47	96	71	4	28	--	-0.3	--	0.6	--	0.2
PN3	1737	64/01/35	47	98	71	2	26	--	0.3	--	2	--	0.4
PN2	1044	41/05/54	50	100	60	--	25	--	4	--	7	--	4
	More than 11% PNA												
ADR1	1160	12/31/57	52	94	59	6	15	--	6	--	11	--	8
ADRC	841	09/29/62	54	94	69	2	15	2	5	--	4	2	7
AK1	448	26/17/57	52	97	63	3	12	--	5	--	14	--	5
AX3	326	33/22/45	47	95	81	5	19	--	-1	--	1	--	0
AX2	603	29/21/50	50	88	66	7	21	--	4	4	6	--	3
AX1	324	04/39/57	52	82	56	9	15	9	8	--	13	--	7
AXC	191	09/25/66	54	97	59	--	21	2	3	--	9	1	7
CS1	1022	23/21/56	52	100	55	--	19	--	7	--	11	--	8
CSC	414	25/12/63	54	103	67	-1	24	-2	--	--	4	--	5
FTGC	256	10/28/62	54	100	53	2	21	-2	5	--	10	--	10
HM2	1013	33/19/48	50	94	59	5	23	--	4	--	9	--	4
HM1	515	30/15/55	52	98	61	5	15	-3	6	--	11	--	7
HMC	605	15/22/63	54	103	63	--	24	-3	2	--	3	--	7
PN1	823	18/22/60	52	91	61	4	12	--	6	5	14	--	6
PNC	620	06/30/64	54	102	71	--	8	-2	4	--	10	--	6
RM1	356	22/23/55	52	95	52	3	25	--	6	--	9	2	7
RMC	478	09/28/63	54	97	53	--	22	--	6	--	9	3	9
TM1	599	20/25/55	52	96	62	2	20	--	3	2	9	--	5
TMC	435	06/31/63	54	83	66	6	14	4	5	--	10	7	5

TABLE 5b

Comparison of a Dichotomous (Advanced-Not Advanced--A51, A55) and a Continuous (Final Multiple Score--F51) Criterion on Proportionate Influence of Components (Series 51, August 1969; and Simulated Series 55, August 1970 Data)

Criteria: F51--FMS, Series 51
A51--Advanced/Not Advanced, Series 51
A55--Advanced/Not Advanced, Simulated Series 55

Rate	N[a]	rβ Weights														
		Component														
		EXAM			PERF			LOS			TIR			AWD		
		F51	A51	A55	F51	A51	A55	F51	A51	A55	F51	A51	A55	F51	A51	A55
ABH3	407	77.4	90.3	73.3	21.1	9.7	21.3	---	0.6	0.5	1.2	-0.9	4.4	0.4	0.5	0.7
AX3	51	78.0	85.4	69.7	23.0	0.8	2.1	-0.8	0.6	47.2	1.3	3.8	-4.9	-1.5	9.4	-14.1
HM3	1653	68.4	100	90.6	32.8	-0.5	11.5	-0.8	-3.0	-2.0	-0.6	3.6	---	0.2	0.3	---
PN3	589	74.8	87.0	96.3	22.9	12.6	1.9	---	0.6	1.1	0.7	-0.2	1.5	-0.5	---	-0.7
ABH2	263	76.0	101.9	93.5	20.1	0.2	1.4	1.0	-4.4	1.6	3.0	-0.5	---	---	2.9	3.5
ADJ2	1453	76.0	80.8	96.6	19.0	10.8	3.4	1.9	1.0	1.4	1.3	---	-1.0	2.0	7.4	-0.2
AX2	55	69.2	23.2	85.2	26.5	4.6	0.2	4.2	6.9	13.2	---	57.9	-0.2	---	7.6	1.6
FTG2	424	75.9	97.8	91.9	19.6	---	7.3	1.2	-8.2	-6.4	2.5	9.5	7.1	0.8	0.7	0.2
FTM2	441	71.4	85.1	84.4	29.3	17.5	16.5	---	0.6	-4.5	-0.6	-1.3	2.9	---	-2.0	0.5
HM2	2267	78.0	90.8	91.1	20.5	10.0	9.7	0.1	-0.8	-0.9	0.6	-0.3	-0.6	0.8	---	0.7
PN2	911	75.3	91.1	95.8	18.2	6.3	4.8	2.3	0.7	-0.6	2.3	---	-0.2	1.0	2.2	---
SD2	1804	61.9	69.2	74.1	14.7	18.7	15.4	12.2	7.7	7.4	5.2	1.1	---	5.9	3.3	2.5
ABH1	176	50.0	69.5	76.7	30.0	1.6	3.4	6.8	3.2	2.2	5.7	1.6	0.4	7.4	24.2	17.2
ADJ1	451	53.6	43.4	83.8	11.2	---	3.2	14.7	-1.2	6.1	8.7	13.2	-0.4	11.9	44.6	7.4
AT1	563	41.9	54.1	99.1	13.4	8.3	---	15.2	18.4	1.8	17.7	12.8	0.2	11.8	6.4	-1.1
AX1	123	58.8	64.6	69.1	16.4	8.3	1.8	7.0	13.5	22.0	12.3	---	-1.2	5.2	13.5	8.3
FTG1	139	62.0	93.6	96.9	22.4	2.2	0.4	14.2	5.9	3.6	1.0	-1.0	-1.4	0.5	-0.8	0.5
FTM1	378	63.5	99.1	94.1	15.2	0.5	7.4	8.2	2.8	-0.8	8.2	-1.3	-0.2	4.9	-1.4	-0.4
HM1	877	53.9	98.5	75.4	16.8	0.3	5.1	11.8	-0.7	3.7	7.1	---	3.7	10.4	2.0	12.1
MN1	49	41.6	87.3	94.8	1.9	0.5	3.6	6.1	10.2	1.8	21.3	1.8	-0.3	29.1	0.2	---

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TABLE 5b (Continued)

Rate	N[a]	rβ Weights														
		EXAM			PERF			Component LOS			TIR			AWD		
		F51	A51	A55	F51	A51	A55	F51	A51	A55	F51	A51	A55	F51	A51	A55
PN1	519	47.4	18.3	42.4	14.4	1.7	2.9	13.2	13.9	3.8	16.8	77.2	50.0	8.3	-11.1	0.9
RM1	729	50.4	91.7	72.5	13.5	2.3	4.0	16.8	3.8	6.5	11.3	1.0	14.5	8.0	1.5	2.5
SD1	1140	65.0	59.8	68.1	11.2	6.1	3.8	11.2	12.1	8.9	4.1	---	-0.4	8.6	22.0	19.6
TMO1	201	53.1	72.3	75.6	19.2	24.4	8.3	14.9	1.7	17.8	4.0	0.8	---	8.6	1.7	-1.7
TMT1	179	32.0	39.2	42.2	16.0	22.1	13.6	16.2	1.7	7.0	26.9	23.2	24.4	8.8	13.8	13.2
ABHC	206	56.4	79.4	53.6	24.3	-0.4	-0.6	4.8	7.1	5.4	7.6	8.2	23.8	6.8	5.7	17.3
ADJC	643	57.6	80.4	81.4	11.1	2.3	2.1	13.1	8.1	8.8	6.4	0.6	1.0	11.6	8.7	6.7
ATC	684	52.5	53.9	79.0	11.9	7.0	1.2	6.8	8.7	2.9	19.0	20.9	5.3	9.8	9.6	11.1
AXC	79	64.5	65.4	56.8	13.9	-0.6	-2.0	7.1	19.0	-1.6	5.8	13.7	1.2	8.6	2.6	45.6
EMC	879	56.1	54.1	77.2	10.7	---	1.8	9.4	---	1.2	15.6	18.4	9.3	8.0	27.6	9.9
FTGC	101	57.0	87.3	95.2	28.8	0.4	6.7	2.5	5.0	1.0	3.4	3.9	-1.7	8.2	3.3	-1.2
FTMC	73	57.0	97.0	107.2	7.6	0.8	0.8	14.6	4.6	-6.0	13.5	3.9	3.4	7.5	-6.3	-5.3
HMC	866	61.6	78.8	72.2	11.5	3.5	4.0	6.4	0.4	4.0	10.4	3.5	2.8	10.2	13.9	17.0
MMC	1200	70.0	81.2	86.6	12.6	6.9	4.7	6.0	2.0	2.0	3.0	5.0	3.4	8.5	5.9	3.4
MNC	13	61.2	102.8	92.9	1.3	-0.1	2.5	5.6	-5.1	5.0	24.4	-0.1	2.3	7.6	2.5	-2.6
PNC	498	60.8	70.9	95.8	11.2	4.7	1.2	4.8	6.9	-0.3	16.9	9.4	3.6	6.0	8.1	-0.1
RMC	1730	56.5	72.4	74.7	10.6	10.3	10.4	8.2	3.4	2.6	16.0	4.3	7.1	8.7	9.5	5.8
SDC	383	77.6	109.5	105.6	10.1	1.4	0.8	3.4	-6.8	-5.9	4.2	---	0.3	4.7	-4.1	-1.1
TMOC	178	64.3	88.8	88.0	10.3	1.2	---	1.8	6.2	0.4	17.6	2.5	8.4	6.2	1.9	3.1
TMTC	179	32.0	39.2	42.2	16.0	22.1	13.6	16.2	1.7	7.0	26.9	23.2	24.4	8.8	13.8	13.2

[a]Rate group N's vary slightly from those of Table 4 because candidates for Warrant Officer and those with discrepant component data were excluded.

TABLE 6

Differences Among Ratings and Pay Grades in Proportionate Influence Of Components (Simulated Series 55, August 1970, Data)

Pay Grade	No. of Ratings	rβ Weights Component EXAM Range	EXAM Mdn	PERF Range	PERF Mdn	LOS Range	LOS Mdn	TIR Range	TIR Mdn	AWD Range	AWD Mdn
4	4	69.7-97.1	82.0	0.4-21.3	6.8	-2.0-47.2	0.6	-4.9-4.4	0.8	-14.1-0.4	0.0
5	8	74.1-96.6	91.5	0.2-16.5	6.1	-6.4-13.2	0.4	-1.0-7.1	-0.1	-0.2-3.5	0.6
6	13	42.2-99.1	75.6	0.0-13.6	3.6	-0.8-22.0	4.9	-1.4-43.4	0.0	-1.7-19.6	2.9
7	15	55.6-109.5	79.2	-2.0-10.4	1.0	-6.0-8.8	1.9	0.0-23.8	3.4	-5.3-45.6	3.4

Note. -- rβ weights obtained from dichotomous criterion, Advanced-Not Advanced.

TABLE 7

Proportionate Influences of Components Among the Operational (Method 1) and Four Experimental (Methods 2-5) Weighting Procedures (Simulated Series 55, August 1970, Data)

Rate	N	Method	Component						Percentage				
			EXAM	PERF	LOS	TIR	AWD	PNA[a] BONUS	Series 55 Advanced/ PNA/Fail (A/P/F)	Of Previous PNA's No. of PNA's: 1	2	3	4
ABH3	412	1	73.3	21.3	0.5	4.4	0.7	NA	90/06/04	27	8	1	-
		2	72.1	21.0	0.2	3.7	1.1	2.1					
		3	72.4	20.7	0.7	3.2	1.2	2.1					
		4	72.4	20.7	0.7	3.2	1.2	2.1					
		5	74.0	20.7	0.5	4.2	0.7	NA					
PN3	579	1	96.3	1.9	1.1	1.5	-0.7	NA	94/00/06	20	8	-	-
		2	95.9	1.8	1.1	1.4	-0.7	0.4					
		3	95.9	1.8	1.1	1.4	-0.7	0.4					
		4	95.9	1.8	1.1	1.4	-0.7	0.4					
		5	96.3	1.9	1.1	1.5	-0.7	NA					
ABH2	265	1	93.4	1.4	1.9	-0.2	3.5	NA	72/00/28	-	-	-	-
		2	93.4	1.4	1.9	-0.2	3.5	---					
		3	93.4	1.4	1.9	-0.2	3.5	---					
		4	93.4	1.4	1.9	-0.2	3.5	---					
		5	90.9	6.7	-0.4	-1.1	3.8	NA					
FTG2	433	1	92.0	7.8	-7.2	7.2	0.2	NA	72/00/28	-	-	-	-
		2	92.0	7.8	-7.2	7.2	0.2	---					
		3	92.0	7.8	-7.2	7.2	0.2	---					
		4	92.0	7.8	-7.2	7.2	0.2	---					
		5	73.3	28.5	-2.1	---	0.2	NA					
PN2	903	1	95.8	4.8	-0.6	-0.2	---	NA	72/00/28	21	-	-	-
		2	92.0	4.8	-0.6	---	---	3.8					
		3	92.0	4.8	-0.6	---	---	3.8					
		4	92.0	4.8	-0.6	---	---	3.8					
		5	84.3	16.1	---	-0.4	---	NA					
ABH1	175	1	76.7	3.4	2.2	0.4	17.2	NA	04/38/58	1	-	-	-
		2	76.3	3.4	2.1	0.4	17.6	---					
		3	76.3	3.4	2.1	0.4	17.6	---					
		4	87.9	3.0	---	1.3	7.8	---					
		5	76.7	3.4	2.2	0.4	17.2	NA					
AT1	561	1	99.1	---	1.8	0.2	-1.1	NA	40/00/60	-	-	-	-
		2	98.9	---	1.8	0.2	-1.1	0.2					
		3	98.9	---	1.8	0.2	-1.1	0.2					
		4	98.9	---	1.8	0.2	-1.1	0.2					
		5	89.0	3.7	2.1	3.0	2.1	NA					
FTG1	141	1	96.2	0.2	5.2	-1.2	-0.3	NA	48/00/52	-	-	-	-
		2	96.2	0.2	5.2	-1.2	-0.3	---					
		3	96.2	0.2	5.2	-1.2	-0.3	---					
		4	96.2	0.2	5.2	-1.2	-0.3	---					
		5	91.7	7.6	-1.5	2.4	-0.2	NA					
PN1	519	1	42.4	2.9	3.8	50.0	0.9	NA	04/38/58	4	2	-	-
		2	28.4	3.2	4.0	60.4	-0.9	5.0					
		3	72.3	5.6	5.6	4.5	9.0	2.8					
		4	50.0	3.7	0.9	46.3	---	-0.5					
		5	26.5	2.9	5.5	67.2	-2.1	NA					

(Continued on next page)

TABLE 7 (Continued)

Rate	N	Method	Component						Percentage				
			EXAM	PERF	LOS	TIR	AWD	PNA[a] BONUS	Series 55 Advanced/ PNA/Fail (A/P/F)	Of Previous PNA's No. of PNA's: 1	2	3	4
ABHC	206	1	53.6	-0.6	5.4	23.8	17.3	NA	03/28/67	20	4	1	-
		2	67.3	-0.6	2.4	14.9	4.8	10.7					
		3	84.9	---	---	4.2	1.8	9.6					
		4	59.6	1.4	2.4	1.0	---	35.1					
		5	53.6	-0.6	5.4	23.8	17.3	NA					
ATC	684	1	79.0	1.2	2.9	5.3	11.1	NA	03/28/67	14	4	1	-
		2	36.9	1.3	3.0	---	6.0	53.2					
		3	48.5	0.4	1.3	-0.9	11.9	38.8					
		4	45.4	2.4	1.4	4.8	5.7	40.7					
		5	71.8	1.8	4.1	7.7	15.3	NA					
FTGC	101	1	95.2	6.7	1.0	-1.7	-1.2	NA	12/18/70	-	-	-	-
		2	95.2	6.7	1.0	-1.7	-1.2	---					
		3	95.4	6.7	0.7	-1.9	-1.2	---					
		4	94.7	6.7	1.4	-1.4	-1.2	---					
		5	88.4	8.0	0.5	1.0	2.1	NA					
PNC	498	1	95.8	1.2	-0.3	3.6	-0.1	NA	15/17/68	12	3	2	-
		2	76.2	1.2	-0.9	2.6	-0.2	21.2					
		3	81.0	1.7	-1.7	-0.3	-0.6	19.9					
		4	75.7	2.4	---	1.9	-0.4	21.2					
		5	83.4	3.3	1.5	10.2	1.6	NA					

[a]Not Applicable (NA) since ro PNA Bonus was applied to Method 1 or 5.

TABLE 8

Relative Shift in $r\beta$ Weights From the Operational to Alternative Weighting Methods (Data Source, Table 7)

Direction of Shift[a] by Alternative Method

× - #2 PNA 20 > - #4 PNA 10 (LOS 10)
Δ - #3 PNA 10 (TIR 10) ✓ - #5 Low Cuts

Rate	Advance/ PNA/Fail (%A/P/F)	Component (and Criterion Percentage)														
		EXAM (55%)			PERF (25%)			LOS (7%)			TIR (5%)			AWD (8%)		
		NoCh	TWD	Away	NoCh	TWD	Away	NoCh	TWD	Away	NoCh	TWD	Away	NoCh	TWD	Away
ABH3	90/06/04	×Δ>✓			×Δ>✓			Δ>✓		×	×✓		Δ>	✓	×Δ>	
PN3	94/00/06	×Δ>✓			×Δ>✓			×Δ>✓			×Δ>✓			×Δ>✓		
ABH2	72/00/28	×Δ>✓			×Δ>	✓		×Δ>		✓	×Δ>		✓	×Δ>✓		
FTG2	72/00/28	×Δ>	✓		×Δ>	✓		×Δ>	✓		×Δ>		✓	×Δ>✓		
PN2	72/00/28		×Δ>✓		×Δ>	✓		×Δ>	✓			×Δ>	✓	×Δ>✓		
ABH1	04/38/58	×Δ✓		>	×Δ>✓			×Δ✓		>	×Δ✓	>		×Δ✓	>	
AT1	40/00/60	×Δ>	✓		×Δ>	✓		<Δ>✓			×Δ>	✓		×Δ>	✓	
FTG1	48/00/52	×Δ>	✓		×Δ>	✓		×Δ>		✓	×Δ>	✓		×Δ>✓		
PN1	04/38/58		>	×Δ✓	×✓	Δ>		×	Δ✓	>	✓	Δ	×✓		Δ	×>✓
ABHC	03/28/67	✓		×Δ>	×✓	Δ>		✓		×Δ>	✓	×Δ>		✓	×Δ>	
ATC	03/28/67		×Δ>✓		×✓	>	Δ	×	✓	Δ>	>		×Δ✓	Δ	×>	✓
FTGC	12/18/70	×Δ>	✓		×Δ>	✓		×Δ>✓			×Δ>	✓		×Δ>	✓	
PNC	15/17/68		×Δ>✓		×Δ	>✓			>✓	×Δ			×Δ>✓		✓	×Δ>
Summary:																
Method #2 "×"	Total	-	3	2	-	0	0	-	0	3	-	2	3	-	3	2
	TWD minus Away		1			0			-3			-1			1	
#3 "Δ"	Total	-	3	2	-	2	1	-	1	3	-	3	3	-	3	1
	TWD minus Away		1			1			-2			0			2	
#4 ">"	Total	-	4	2	-	4	0	-	1	4	-	3	2	-	4	2
	TWD minus Away		2			4			-3			1			2	
#5 "✓"	Total	-	7	1	-	7	0	-	5	2	-	3	6	-	3	2
	TWD minus Away		6			7			3			-3			1	

[a]The shift is indicated in reference to a change from the operational weight, Towards (TWD, i.e., converging on), Away from (i.e., diverging), or No Change (NoCh) from, the criterion for that component. (The criteria used for this demonstration were selected from values between the policy weights of Table 1 and the expressed preference weights of Figure 2.

The extent of the relative shift was considered "No Change" (NoCh) unless the shift:

For $r\beta$ Size	Resulted in a relative shift greater than
02.00 or less	50%
02.01 - 05.00	25%
05.01 - 50.00	10%
50.01 or greater	3%

Example: Consider the shift in two components by Methods 1 (operational) vs 4, and 1 vs 5 for the FTGC rate:

Method	Component: EXAM
1 vs 4	95.2 vs 94.7, thus "No Change" (NoCh)
1 vs 5	88.4 vs 95.2, a difference of 6.8 (greater than 3%) "Toward" the criterion of 55 percent.
	Component: TIR
1 vs 4	-1.7 vs -1.4, thus "No Change" (NoCh).
	-1.7 vs 1.0, a difference of 2.7 (greater than 50%) "Toward" the criterion of 7 percent.

TABLE 9

Proportion of Candidates Uniquely Selected by Four Alternative Experimental Weighting Procedures in Comparison With the Present Operational (Method 1) System (Simulated Series 55)

Rate		Candidates		Proportion of Advanced Candidates Uniquely Selected by Experimental vs Operational Method				Incidence of Previous PNA[a]				
		Total	Advanced	Experimental Method[b]				0 (1st try)	1	2	3	4 or more
				2	3	4	5					
ABH3	N	418	376	1	1	1	-	136	113	33	5	-
	%	-	-	.3	.3	.3	-	33	27	8	1	-
PN3	N	605	541	-	-	-	-	221	119	46	-	-
	%	-	-	-	-	-	-	37	20	8	-	-
ABH2	N	265	191	-	-	-	9	241	-	-	-	-
	%	-	-	-	-	-	5	91	-	-	-	-
FTG2	N	436	314	-	-	-	22	359	-	-	-	-
	%	-	-	-	-	-	7	82	-	-	-	-
PN2	N	911	656	1	2	2	31	448	189	2	-	-
	%	-	-	.2	.3	.3	5	49	21	0.2	-	-
ABH1	N	176	7	-	-	1	-	83	2	-	-	-
	%	-	-	-	-	14	-	47	1	-	-	-
AT1	N	563	225	-	-	-	53	328	1	-	-	-
	%	-	-	-	-	-	24	58	0.2	-	-	-
FTG1	N	141	68	-	-	-	13	72	-	-	-	-
	%	-	-	-	-	-	19	51	-	-	-	-
PN1	N	519	21	3	5	2	2	258	23	9	-	-
	%	-	-	14	24	10	10	50	4	2	-	-
ABHC	N	230	7	1	2	4	-	60	45	9	2	-
	%	-	-	14	29	57	-	26	20	4	1	-
ATC	N	749	22	5	3	4	1	279	105	33	6	2
	%	-	-	23	14	18	4	37	14	4	.8	.3
FTGC	N	134	16	-	-	-	3	78	-	-	-	-
	%	-	-	-	-	-	19	58	-	-	-	-
PNC	N	626	94	8	12	13	13	156	78	21	10	1
	%	-	-	8	13	14	14	25	12	3	2	0.2

[a]Does not sum to 100 percent since incidence of previous exam-fails not included.

[b]Defined in paragraphs B.2.a. and B.2.b.

TABLE 10

Comparative Differences in Candidates Uniquely Selected by Experimental (Methods 2-5) vs Operational (Method 1) Procedures[a]

Rate N Advanced	Uniquely Selected N[c]	%	Method[d]	Component Mean of Candidates Uniquely Selected[b] EXAM	PERF	LOS	TIR	AWD	Frequency of Previous PNA	Fail
ABH3 376	1	0.3%	1	39.00	3.45	33.00	18.00	----	----	----
			2	41.00	3.40	22.00	13.00	1.00	1.00	----
			1 vs 2	2.00	-.05	-11.00	-5.00	1.00	1.00	----
	1	0.3%	1	37.00	3.50	22.00	20.00	----	----	1.00
			3	41.00	3.40	22.00	13.00	1.00	1.00	----
			1 vs 3	4.00	-.10	----	-7.00	1.00	1.00	-1.00
	1	0.3%	1	37.00	3.50	22.00	20.00	----	----	1.00
			4	41.00	3.40	22.00	13.00	1.00	1.00	----
			1 vs 4	4.00	-.10	----	-7.00	1.00	1.00	-1.00
ABH2 191	9	5%	1	46.44	3.47	34.33	9.77	.33	----	----
			5	42.00	3.67	51.33	16.78	1.00	----	.55
			1 vs 5	-4.44**	.20**	17.00**	7.01 NS	.67 NS	----	.55 NS
FTG2 436	22	5%	1	47.73	3.44	31.55	12.05	.09	----	.14
			5	42.05	3.70	48.82	20.68	.55	----	.77
			1 vs 5	-4.68**	.26**	17.27*	8.63**	.46*	----	.63**
PN2 911	31	4%	1	47.29	3.61	27.81	12.48	.16	.10	.39
			5	42.29	3.85	45.87	20.06	1.00	.13	1.10
			1 vs 5	-5.00**	.24**	18.06**	7.58*	.84**	.03 NS	.71**

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TABLE 10 (Continued)

Rate N Advanced	Uniquely Selected N[c]	%	Method[d]	Component Mean of Candidates Uniquely Selected[b] EXAM	PERF	LOS	TIR	AWD	Frequency of Previous PNA	Fail
ABH1 7	1	14%	1	58.00	3.89	182.00	45.00	8.00	----	3.00
			4	71.00	3.82	82.00	42.00	2.00	----	1.00
			1 vs 4	13.00	-.07	-100.00	-3.00	-6.00	----	-2.00
AT1 225	53	24%	1	56.00	3.65	63.55	27.38	1.68	----	.17
			5	48.79	3.76	145.38	73.55	5.81	----	2.42
			1 vs 5	-7.21**	.11**	81.83**	46.20**	4.13**	----	-2.25**
FTG1 68	13	19%	1	51.92	3.60	68.77	27.69	1.15	----	.58
			5	48.15	3.75	127.85	53.23	3.62	----	1.92
			1 vs 5	-3.77**	.15**	59.08**	26.46**	2.17**	----	1.54**
PN1 21	3	14%	1	72.66	3.87	102.00	32.00	3.00	----	1.33
			2	56.00	3.87	144.33	64.00	4.66	1.33	2.66
			1 vs 2	-16.66*	---- NS	42.33 NS	32.00 NS	1.66 NS	1.33 NS	1.33 NS
	5	24%	1	54.20	3.88	188.80	122.20	6.60	----	4.60
			3	65.40	3.96	113.40	37.20	4.00	.60	1.20
			1 vs 3	11.20**	.08**	-75.40**	-85.00**	-2.60 NS	.60 NS	-3.40**
	2	10%	1	56.00	3.90	182.00	66.00	8.50	.50	4.00
			4	68.00	3.99	94.00	30.00	4.00	----	1.00
			1 vs 4	12.00	.09	-88.00	-36.00	-4.50	-.50	-3.00
	2	10%	1	71.00	3.85	108.50	36.00	3.50	----	2.00
			5	49.00	3.85	223.50	143.50	8.00	----	3.50
			1 vs 5	-22.00	----	115.00	107.50	4.50	----	1.50

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TABLE 10 (Continued)

Rate N Advanced	Uniquely Selected N[c]	%	Method[d]	Component Mean of Candidates Uniquely Selected[b] EXAM	PERF	LOS	TIR	AWD	Frequency of Previous PNA	Fail
ABHC 7	1	14%	1	58.00	3.86	220.00	66.00	12.00	----	3.00
			2	75.00	3.87	128.00	54.00	4.00	1.00	----
			1 vs 2	17.00	.01	-92.00	-12.00	-8.00	1.00	-3.00
	2	28%	1	59.50	3.84	207.00	94.00	10.50	.50	4.50
			3	76.50	3.80	123.00	48.00	4.00	1.00	1.00
			1 vs 3	17.00	-.04	-84.00	-46.00	-6.50	.50	-3.50
	4	57%	1	61.75	3.82	210.25	71.50	10.25	.25	3.75
			4	71.25	3.86	125.00	51.00	5.50	1.25	1.25
			1 vs 4	9.50 NS	.04 NS	-85.25**	-20.50 NS	-4.75**	1.00*	-2.50*
ATC 22	5	23%	1	67.00	3.78	162.00	71.80	9.20	0.20	1.60
			2	65.20	3.79	164.40	69.80	7.20	2.20	1.20
			1 vs 2	-1.80 NS	.01 NS	2.40 NS	-2.00 NS	-2.00 NS	2.00**	-.40 NS
	3	14%	1	58.00	3.87	192.00	123.66	6.66	.33	4.00
			3	66.00	3.79	164.66	60.33	7.33	2.33	.33
			1 vs 3	8.00**	-.08 NS	-27.34 NS	-63.33*	.67 NS	2.00 NS	-3.67**
	4	18%	1	63.75	3.80	168.25	79.25	10.50	----	2.00
			4	65.00	3.87	136.25	77.25	6.50	1.75	1.00
			1 vs 4	1.25 NS	.07 NS	-32.00	-2.00 NS	-4.00 NS	1.75 NS	-1.00 NS
	1	5%	1	74.00	3.78	140.00	48.00	6.00	2.00	----
			5	49.00	3.89	226.00	121.00	15.00	----	5.00
			1 vs 5	-25.00	.11	86.00	73.00	9.00	-2.00	5.00

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TABLE 10 (Continued)

Rate N Advanced	Uniquely Selected N[c]	%	Method[d]	Component Mean of Candidates Uniquely Selected[b] EXAM	PERF	LOS	TIR	AWD	Frequency of Previous PNA	Fail
FTGC 16	3	19%	1	57.00	3.85	105.66	42.33	3.66	----	.33
			5	51.33	3.86	155.33	66.00	7.00	----	1.33
			1 vs 5	-5.67**	.01 NS	49.67 NS	23.67 NS	3.34 NS	---- NS	1.00 NS
PNC 94	8	9%	1	62.00	3.89	158.00	53.25	7.13	----	2.63
			2	62.00	3.87	156.88	54.63	6.13	1.38	1.25
			1 vs 2	---- NS	-.02 NS	-1.12 NS	1.38 NS	-1.00 NS	1.38**	-1.38 NS
	12	13%	1	57.08	3.87	177.75	89.50	7.42	.25	4.25
			3	61.92	3.89	159.08	49.42	6.25	1.17	1.25
			1 vs 3	4.84**	.02 NS	-18.67*	-40.08**	-1.17*	.92**	-3.00**
	13	14%	1	58.62	3.87	181.62	65.08	8.15	.08	3.62
			4	62.54	3.93	137.31	50.69	5.54	1.15	1.00
			1 vs 4	3.92**	.06*	-44.31**	-14.39*	-2.61**	1.07**	-2.62**
	13	14%	1	62.00	3.88	159.10	58.62	6.46	1.10	2.10
			5	51.46	3.95	218.92	114.50	9.85	.08	4.46
			1 vs 5	-10.54**	.07*	59.82**	55.88**	3.39**	-1.02*	2.36**
Combined High PNA Rates: PN1 ABHC ATC 50	9	18%	1	67.89	3.81	148.44	57.89	7.44	.11	1.67
			2	63.22	3.82	153.67	66.11	6.00	1.78	1.56
			1 vs 2	-4.67 NS	.01 NS	5.23 NS	8.22 NS	-1.44 NS	.67 NS	-.11 NS
	10	20%	1	56.40	3.87	193.40	115.00	7.40	.20	4.40
			3	67.80	3.88	130.70	46.30	5.00	1.20	.90
			1 vs 3	11.40**	.01 NS	-62.70**	-68.70**	-2.40*	1.00*	-3.50**
	10	20%	1	61.40	3.83	187.80	73.50	10.00	.20	3.10
			4	68.10	3.89	123.30	57.30	5.60	1.20	1.10
			1 vs 4	6.70*	.06 NS	-64.50**	-16.20 NS	-4.40**	1.00*	-2.00**
	3	6%	1	72.00	3.82	119.00	40.00	4.33	.67	1.33
			5	49.00	3.86	224.33	136.00	10.33	----	4.00
			1 vs 5	-23.00**	.04 NS	105.33**	96.00**	6.00 NS	-.67 NS	2.67 NS

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TABLE 10 (Continued)

Rate N Advanced	Uniquely Selected N[c]	%	Method[d]	Component Mean of Candidates Uniquely Selected[b] EXAM	PERF	LOS	TIR	AWD	Frequency of Previous PNA	Fail
Combined High PNA Rates: PN1 PNC ABHC ATC 144	17	12%	1	65.12	3.85	152.94	55.71	7.30	.06	2.12
			2	62.65	3.84	155.18	60.71	6.06	1.59	1.41
			1 vs 2	-2.47 NS	-.01 NS	2.24 NS	5.00 NS	-1.24 NS	1.53**	-.71 NS
	22	15%	1	56.77	3.87	184.86	101.09	7.41	.14	4.32
			3	64.59	3.89	146.18	48.00	5.68	1.18	1.09
			1 vs 3	7.82**	.02 NS	-38.68**	-53.09**	-1.73**	1.04**	-3.23**
	23	16%	1	59.83	3.85	184.30	68.74	8.96	.13	3.39
			4	64.96	3.91	131.22	53.57	5.57	1.17	1.04
			1 vs 4	5.13**	.06*	-53.08**	-15.17*	-3.39**	1.04**	-2.35**
	16	11%	1	63.88	3.87	151.56	55.12	6.06	1.00	1.94
			5	51.00	3.93	219.94	118.50	9.94	.06	4.38
			1 vs 5	-12.88**	.06 NS	68.38**	63.38**	3.88**	-.94*	2.44**

[a]After selections were made by applying the cut-off points of Table 1 and paragraph B.2.b., means were recomputed from the actual (i.e., complete range of) component values in order to show the actual characteristics of the candidates.

[b]In comparisons of Method 1 vs 2/3/4/5, a negative value indicates that the component mean by the experimental method decreased.

[c]Significance tests were not performed on uniquely selected groups with $N < 3$.

[d]Data are not presented if the experimental method did not select any candidates uniquely.

*$p < .05$

**$p < .01$

NS - Not significant

TABLE 11

Computer-Generated Display of Proportion of Advancements (A), PNA--Quota (Q), and Exam-Fail (F) Selected from Each Rank-Ordered Component Quarter by Alternative Weighting Method

TETRA SUMMARY FOR ABH3

EXAM COMPONENT

METHOD	QUARTER 1				QUARTER 2				QUARTER 3				QUARTER 4			
	A	Q	F	(N)	A	Q	F	(N)	A	Q	F	(N)	A	Q	F	(N)
1	99	0	0	103	99	0	0	103	98	2	0	103	67	20	13	103
2	99	0	0	103	99	0	0	103	98	2	0	103	67	20	13	103
3	99	0	0	103	99	0	0	103	98	2	0	103	67	20	13	103
4	99	0	0	103	99	0	0	103	98	2	0	103	67	20	13	103
5	99	0	0	103	99	0	0	103	98	2	0	103	67	20	13	103
RANGE	MAX= 79 MIN= 60				MAX= 60 MIN= 54				MAX= 54 MIN= 46				MAX= 46 MIN= 20			

PERF COMPONENT

METHOD	QUARTER 1				QUARTER 2				QUARTER 3				QUARTER 4			
	A	Q	F	(N)	A	Q	F	(N)	A	Q	F	(N)	A	Q	F	(N)
1	97	0	3	103	97	0	3	103	91	5	4	103	80	17	3	103
2	97	0	3	103	97	0	3	103	90	6	4	103	81	17	3	103
3	97	0	3	103	97	0	3	103	90	6	4	103	81	17	3	103
4	97	0	3	103	97	0	3	103	90	6	4	103	81	17	3	103
5	97	0	3	103	97	0	3	103	91	5	4	103	80	17	3	103
RANGE	MAX= 395 MIN= 366				MAX= 366 MIN= 355				MAX= 355 MIN= 345				MAX= 345 MIN= 290			

TABLE 12

Proportion of Advancements Selected by Alternative Weighting Methods From Each Rank-Ordered Quarter for Each Component (13 Rate Groups)

Rate and Quarter N	Method	Percentage[a] of Advancements From Top (T), 2nd, 3rd, Bottom (B) Quarter of Component																			
		EXAM				PERF				LOS				TIR				AWD			
		T	2	3	B	T	2	3	B	T	2	3	B	T	2	3	B	T	2	3	B
ABH3 103	1	99	99	98	67	97	97	91	80	95	91	88	90	96	95	86	87	94	97	91	83
	2	99	99	98	67	97	97	90	81	95	90	88	91	96	95	85	88	95	97	90	83
	3	99	99	98	67	97	97	90	81	95	91	88	90	96	94	86	88	95	97	90	83
	4	99	99	98	67	97	97	90	81	95	91	88	90	96	94	86	88	95	97	90	83
	5	99	99	98	67	97	97	91	80	95	91	88	90	96	95	86	87	94	97	91	83
PN3 145	1	99	99	99	74	98	94	94	88	93	93	94	93	94	94	92	93	94	96	94	89
	2	99	99	99	74	98	94	94	88	93	93	94	93	94	94	92	93	94	96	94	89
	3	99	99	99	74	98	94	94	88	93	93	94	93	94	94	92	93	94	96	94	89
	4	99	99	99	74	98	94	94	88	93	93	94	93	94	94	92	93	94	96	94	89
	5	99	99	99	74	98	94	94	88	93	93	94	93	94	94	92	93	94	96	94	89
ABH2 66	1	99	99	89	--	71	77	76	64	45	77	74	91	53	74	82	79	52	77	83	76
	2	99	99	89	--	71	77	76	64	45	77	74	91	53	74	82	79	52	77	83	76
	3	99	99	89	--	71	77	76	64	45	77	74	91	53	74	82	79	52	77	83	76
	4	99	99	89	--	71	77	76	64	45	77	74	91	53	74	82	79	52	77	83	76
	5	99	99	82	09	73	85	73	58	53	76	70	90	59	71	82	72	59	77	80	72
FTG2 108	1	99	99	89	03	75	81	70	64	55	69	87	79	56	74	77	83	66	86	72	66
	2	99	99	89	03	75	81	70	64	55	69	87	79	56	74	77	83	66	86	72	66
	3	99	99	89	03	75	81	70	64	55	69	87	79	56	74	77	83	66	86	72	66
	4	99	99	89	03	75	81	70	64	55	69	87	79	56	74	77	83	66	86	72	66
	5	99	94	75	21	87	85	68	50	65	68	82	75	62	74	74	80	75	90	72	53

(Continued on next page)

TABLE 12 (Continued)

Rate and Quarter N	Method	Percentage[a] of Advancements From Top (T), 2nd, 3rd, Bottom (B) Quarter of Component																			
		EXAM				PERF				LOS				TIR				AWD			
		T	2	3	B	T	2	3	B	T	2	3	B	T	2	3	B	T	2	3	B
PN2 206	1	99	99	90	01	80	77	73	60	68	74	73	76	69	72	71	79	69	82	75	64
	2	99	99	90	01	80	77	73	60	68	74	73	76	69	73	71	78	69	82	75	64
	3	99	99	90	01	80	77	73	60	68	75	73	75	69	73	71	78	69	82	75	64
	4	99	99	90	01	80	77	73	60	68	75	73	75	69	73	71	78	69	82	75	64
	5	99	98	77	15	87	80	72	51	73	72	73	72	73	73	69	76	74	82	74	60
ABH1 44	1	16	--	--	--	07	07	02	--	07	05	02	02	07	05	02	02	09	--	07	--
	2	16	--	--	--	07	07	02	--	07	05	02	02	07	05	02	02	09	--	07	--
	3	16	--	--	--	07	07	02	--	07	05	02	02	07	05	02	02	09	--	07	--
	4	16	--	--	--	07	07	02	--	05	05	02	05	05	07	02	02	07	--	09	--
	5	16	--	--	--	07	07	02	--	07	05	02	02	07	05	02	02	09	--	07	--
AT1 140	1	99	62	--	--	32	40	51	38	24	39	40	57	31	38	43	49	26	42	52	40
	2	99	62	--	--	32	40	51	38	24	39	40	57	31	38	43	49	26	42	52	40
	3	99	62	--	--	32	40	51	38	24	39	40	57	31	38	43	49	26	42	52	40
	4	99	62	--	--	32	40	51	38	24	39	40	57	31	38	43	49	26	42	52	40
	5	86	52	22	--	47	41	46	27	47	46	34	33	56	42	34	28	44	47	44	26
FTG1 35	1	99	91	03	--	46	54	37	56	23	43	46	81	37	40	49	67	31	51	54	56
	2	99	91	03	--	46	54	37	56	23	43	46	81	37	40	49	67	31	51	54	56
	3	99	91	03	--	46	54	37	56	23	43	46	81	37	40	49	67	31	51	54	56
	4	99	91	03	--	46	54	37	56	23	43	46	81	37	40	49	67	31	51	54	56
	5	99	57	37	--	57	54	43	39	40	43	51	58	60	34	51	47	46	54	51	42
PN1 130	1	12	04	--	--	05	07	02	02	11	02	02	01	13	01	02	01	09	04	02	01
	2	12	05	--	--	08	05	02	02	12	02	02	01	14	02	--	01	10	04	02	01
	3	15	01	--	--	11	02	02	02	08	05	03	01	10	02	03	01	08	04	04	01
	4	12	05	--	--	08	05	02	02	09	03	03	01	12	02	03	01	08	04	03	01
	5	11	05	01	--	06	06	02	02	12	01	02	01	14	01	01	01	11	02	02	01

(Continued on next page)

TABLE 12 (continued)

Rate and Quarter N	Method	Percentage[a] of Advancements From Top (T), 2nd, 3rd, Bottom (B) Quarter of Component																			
		EXAM				PERF				LOS				TIR				AWD			
		T	2	3	B	T	2	3	B	T	2	3	B	T	2	3	B	T	2	3	B
ABHC 51	1	14	--	--	--	04	06	02	02	10	--	02	02	10	04	--	--	08	02	04	--
	2	14	--	--	--	04	04	04	02	08	--	02	04	08	04	02	--	06	02	04	02
	3	14	--	--	--	04	04	04	02	06	--	02	06	06	06	02	--	04	02	04	04
	4	14	--	--	--	08	02	04	--	02	--	02	09	04	08	02	--	04	02	04	04
	5	14	--	--	--	04	06	02	02	10	--	02	02	10	04	--	--	08	02	04	--
ATC 171	1	12	01	--	--	05	02	02	03	04	04	04	01	06	02	03	02	06	04	02	01
	2	10	01	--	--	05	03	02	02	03	02	05	01	06	02	02	01	06	02	02	01
	3	11	01	--	--	04	02	02	03	02	04	04	01	05	02	03	02	06	02	02	01
	4	11	01	--	--	04	03	02	02	02	02	05	02	05	02	04	01	05	03	02	01
	5	09	01	01	--	05	03	02	02	04	04	03	01	06	02	03	02	06	04	02	01
FTGC 25	1	60	04	--	--	20	28	16	--	04	12	32	15	04	24	32	04	12	24	12	15
	2	60	04	--	--	20	28	16	--	04	12	32	15	04	24	32	04	12	24	12	15
	3	60	04	--	--	20	28	16	--	04	12	32	15	04	24	32	04	12	24	12	15
	4	60	04	--	--	20	28	16	--	04	12	32	15	04	24	32	04	12	24	12	15
	5	52	12	--	--	24	20	16	04	08	20	20	15	08	20	28	08	20	20	08	15
PNC 124	1	66	10	--	--	25	21	17	13	14	22	20	20	23	31	14	08	15	21	22	17
	2	66	10	--	--	23	23	18	12	13	21	22	20	24	29	14	09	13	23	20	20
	3	72	04	--	--	27	23	15	11	12	19	22	22	16	31	18	11	14	19	24	19
	4	71	05	--	--	27	24	16	09	10	18	20	27	22	27	14	13	11	19	22	24
	5	56	19	01	--	26	24	17	09	20	23	17	15	31	27	10	07	22	23	17	14

[a]A percentage of 99 represents 99 or 100. This procedure was used to conserve space by limiting each column to two digits.

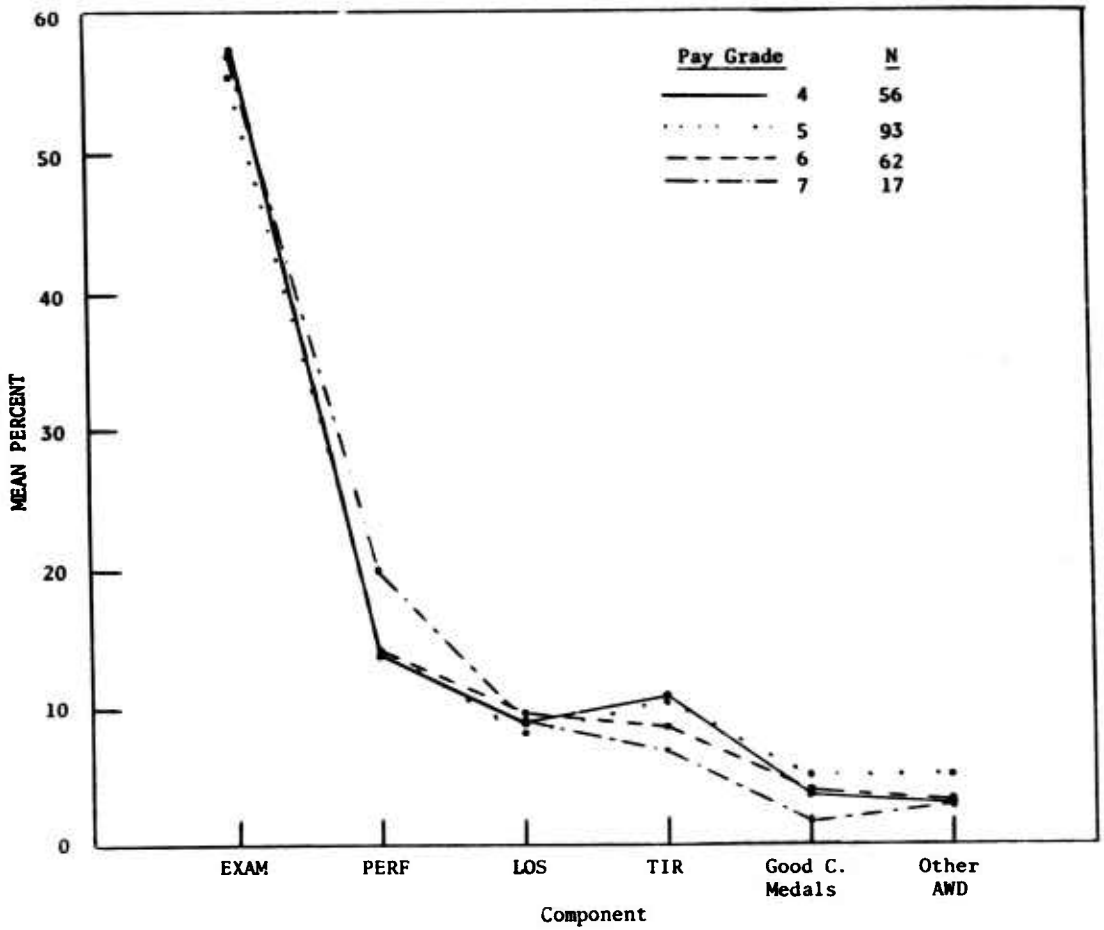


Fig. 1. Opinions of what proportionate influences of advancement components actually are (Question 1).

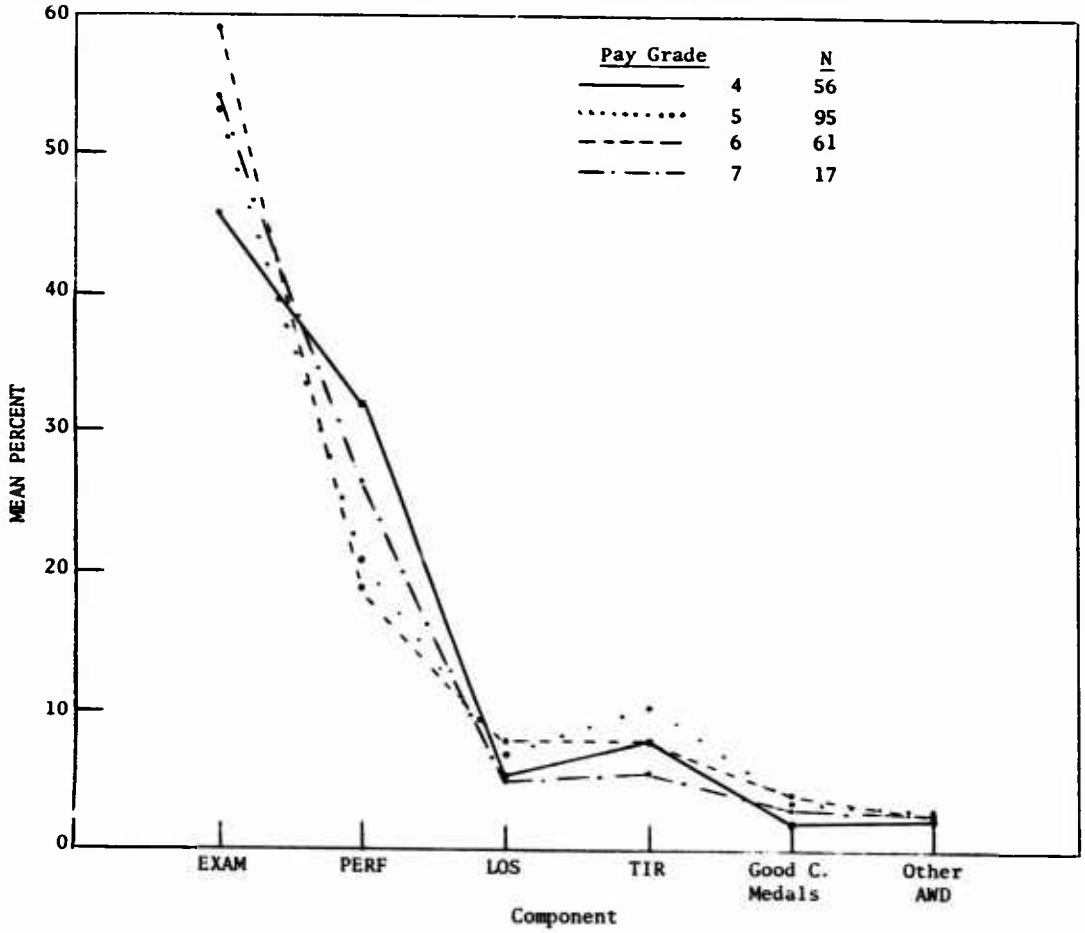


Fig. 2. Opinions of what proportionate influences of advancement components should be (Question 2).

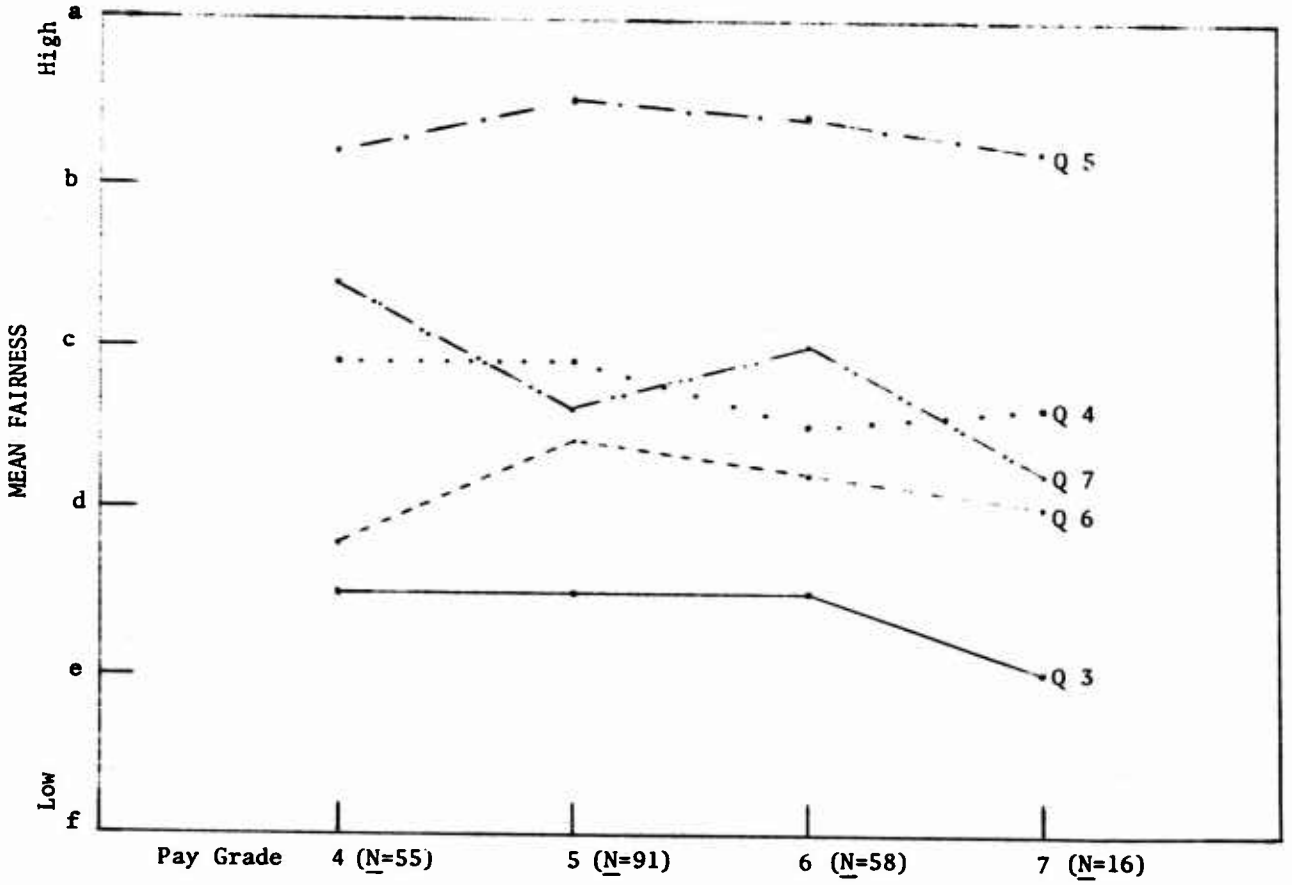


Fig. 3. Opinions, by pay grade, of fairness of alternative sets of proportionate influences of advancement components (Questions 3-7).

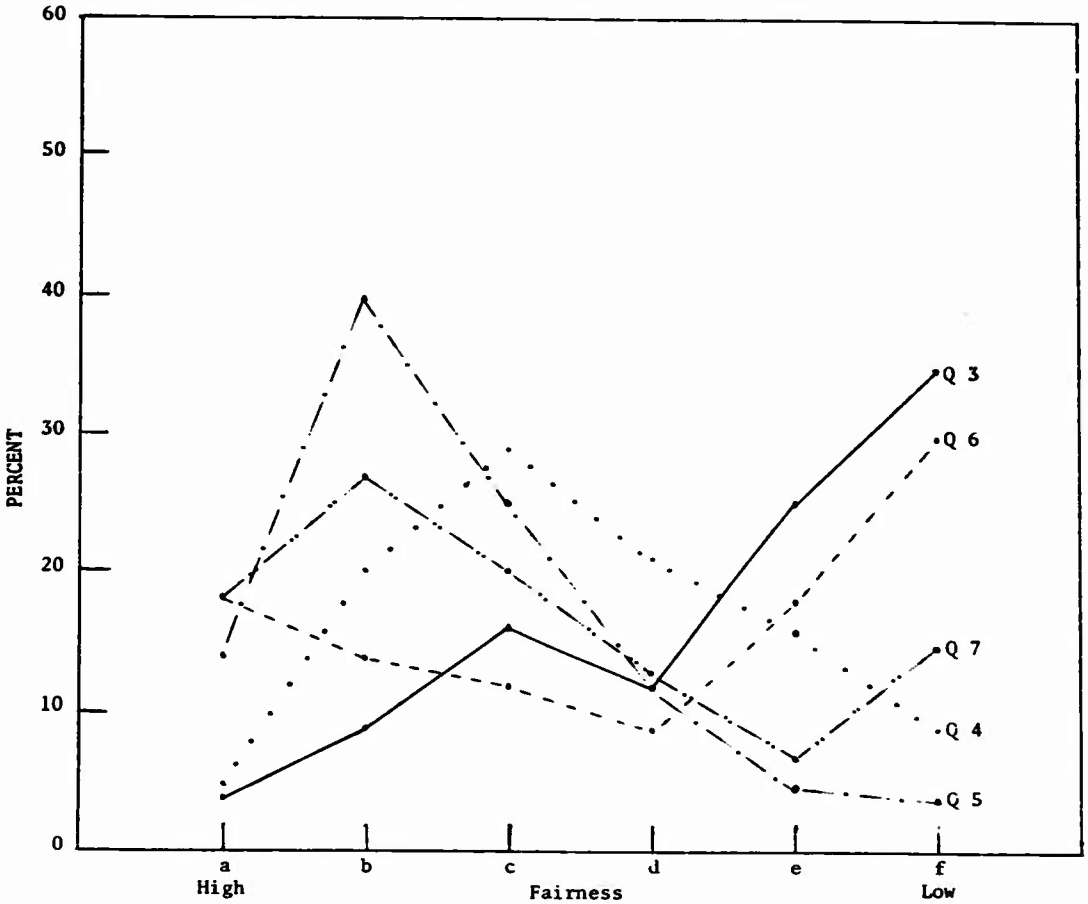


Fig. 4. Opinions of Pay Grade 6 personnel concerning fairness of alternative sets of proportionate influences of advancement components (Questions 3-7).

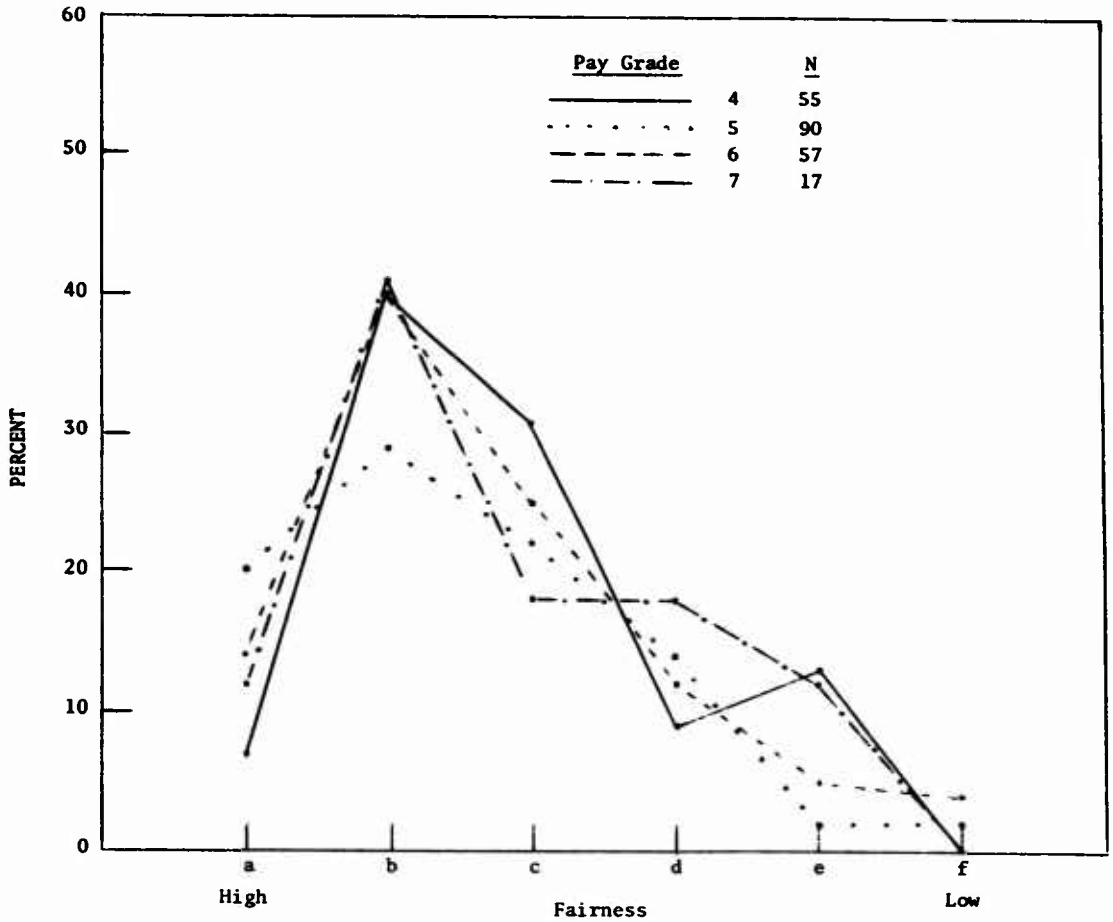


Fig. 5. Opinions, by pay grade, of fairness of an alternative set of proportionate influences of advancement components (Question 5)

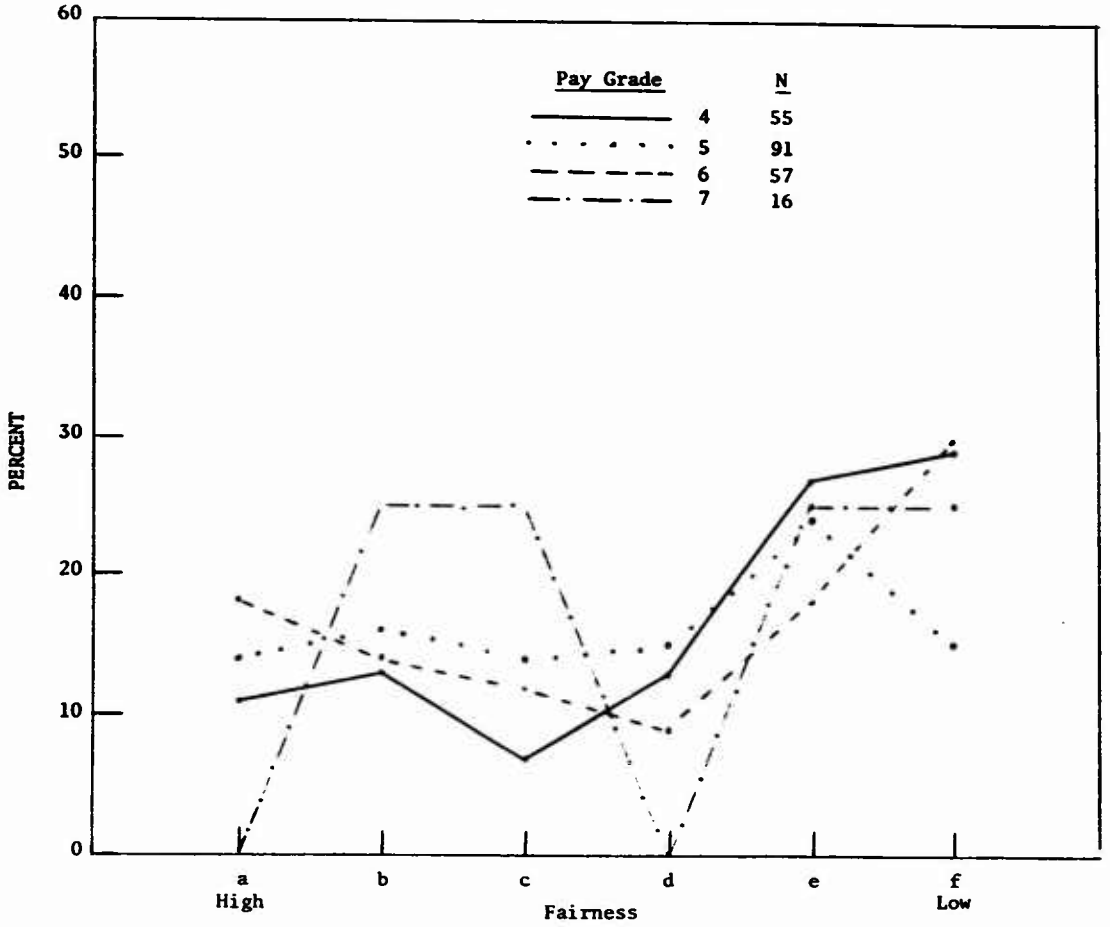


Fig. 6. Opinions, by pay grade, of fairness of an alternative set of proportionate influences of advancement components (Question 6).

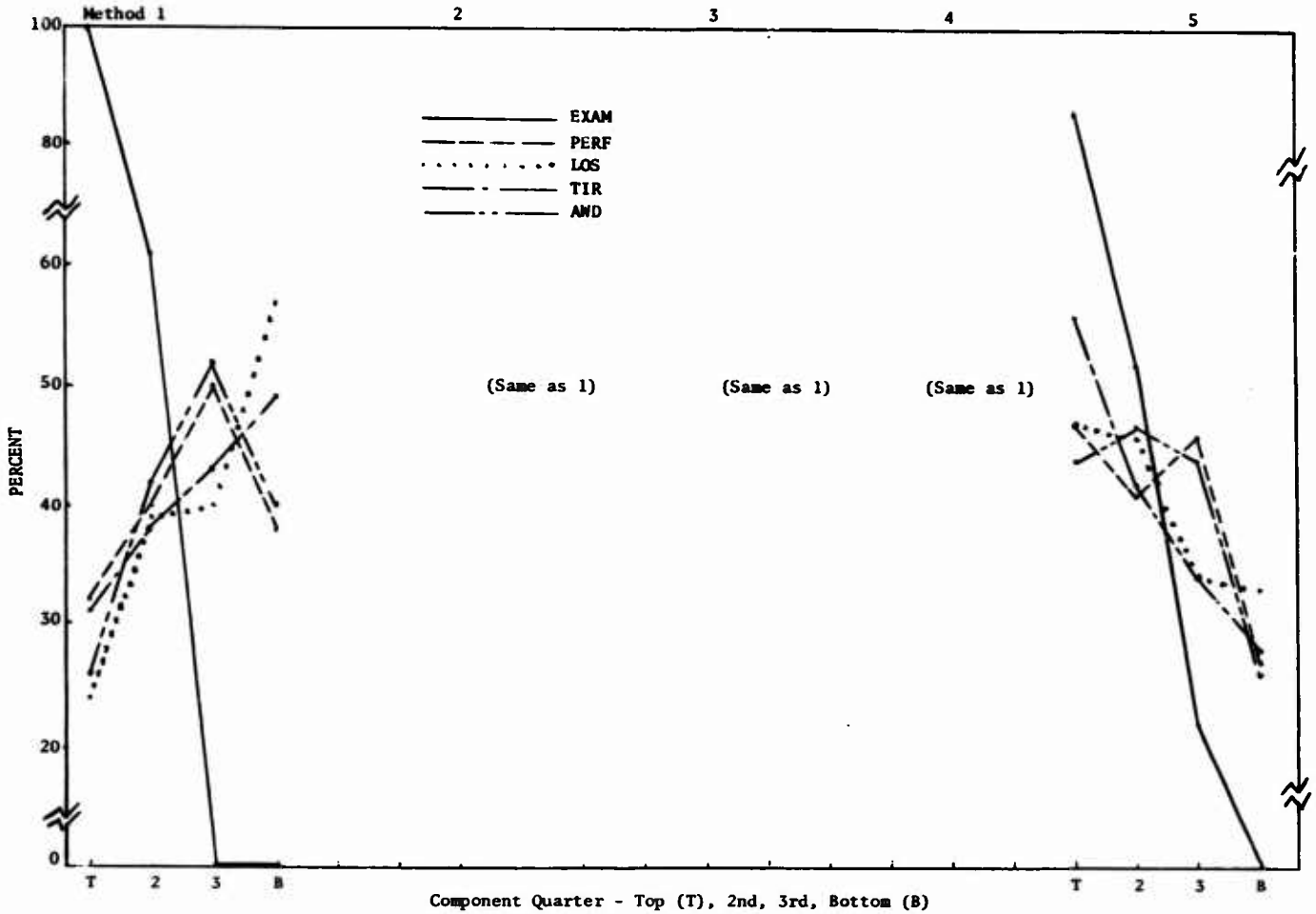
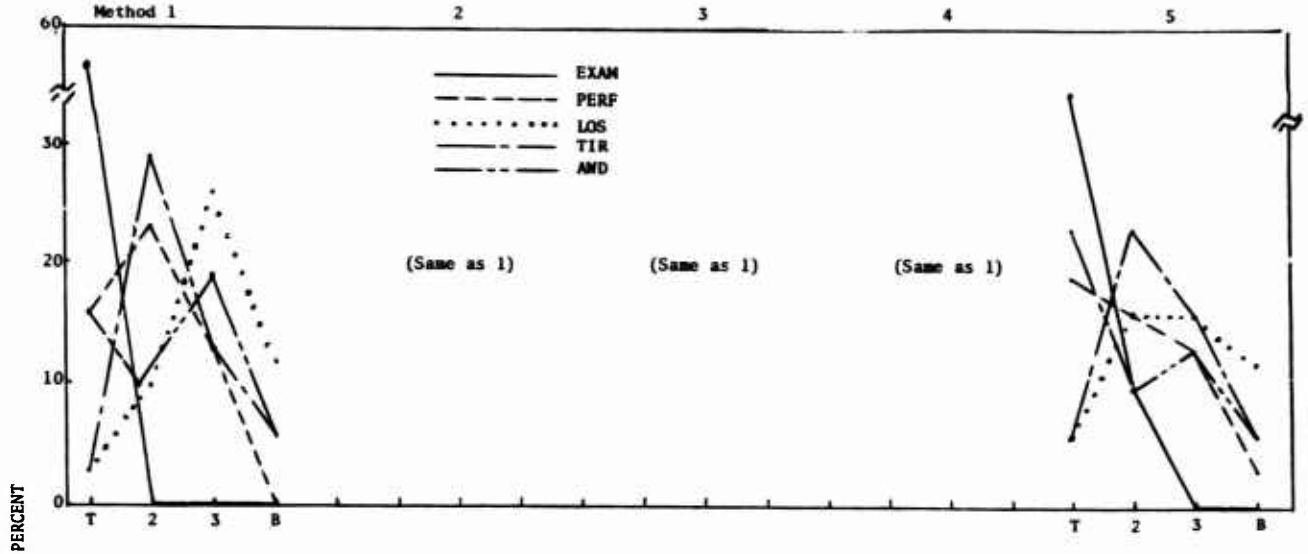


Fig. 7. Proportion of advancements selected from each rank-ordered quarter of each component as related to PNA incidence. (Rate: AT1. PNA Incidence: Present-Low; Previous-Low.)

a. Rate: FTGC. PNA Incidence: Present-High; Previous-Low.



b. Rate: ATC. PNA Incidence: Present-High, Previous-High.

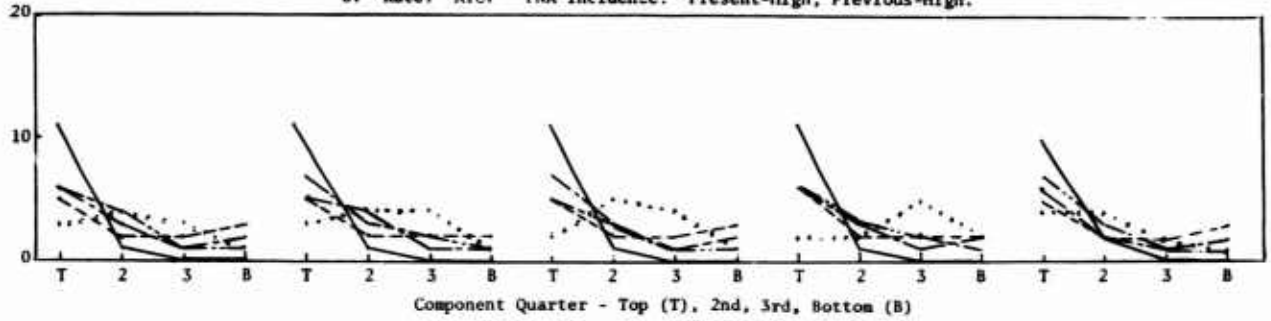


Fig. 8. Proportion of advancements selected from each rank-ordered quarter of each component as related to PNA incidence.

APPENDIX B

Abbreviations and Complete Titles of Navy Ratings Selected for Analysis

APPENDIX B

Abbreviations and Complete Titles of Navy Ratings Selected for Analysis

ABH - Aviation Boatswain's Mate H (Aircraft Handling)

ADJ - Aviation Machinist's Mate J (Jet Engine Mechanic)

ADR - Aviation Machinist's Mate R (Reciprocating Engine Mechanic)

AK - Aviation Storekeeper

AT - Aviation Electronics Technician

AX - Aviation Antisubmarine Warfare (ASW) Technician

CS - Commissaryman

DC - Damage Controlman

DT - Dental Technician

EM - Electrician's Mate

FT - Fire Control Technician

HM - Hospital Corpsman

MM - Machinist's Mate

MN - Mineman

PN - Personnelman

RM - Radioman

SD - Steward

ST - Sonar Technician

TM - Torpedoman's Mate

APPENDIX C

Questionnaire on Factors in Advancement

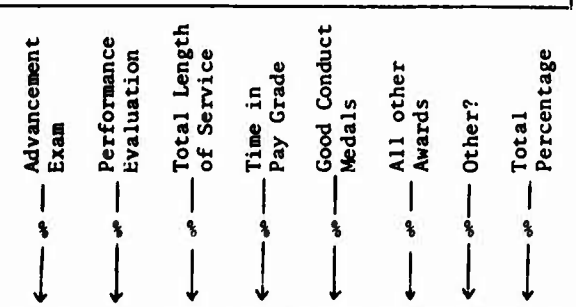
APPENDIX C

THE BASIS OF PROMOTION

Proportionate Influence of Factors in the Enlisted Advancement System

INSTRUCTIONS: At the direction of the Chief of Naval Personnel this Laboratory is conducting a study of factors in the Enlisted Performance Evaluation and Advancement Systems. One of the major questions we are investigating is "What should be the basis of Advancement?" We would appreciate <u>your</u> judgment on this also. Please indicate what you believe the relative or proportionate influences of various factors <u>are</u> and <u>should be</u>, for advancement <u>to your present rate</u> (exception: SCPO's and MCPO's indicate your opinion as it applies to advancement from E-6 <u>to</u> E-7 in your rating).

First, for Questions 1 and 2, indicate what you believe the relative influence of various factors <u>actually are</u> and <u>should be</u> respectively by writing in the boxes percentages which total 100%. For example, if you believe the "Awards" factor is three fourths the influence, and "Time in Rate" is the remaining one fourth influence, you would write in 75% and 25% respectively for those two factors and 00% for all others.



1. What you believe the percentage influences <u>actually are</u> for your rate.

(If "other," indicate: _____)

2. What you think the percentage influences <u>should</u> be.

100

(If "other," indicate: _____)

Next, for Questions 3-7, indicate how fair each of the theoretical combinations would be if it were applied as the basis for advancement to your rate:

a = Completely Fair
b = Mostly Fair
c = Slightly Fair
d = Slightly Unfair
e = Largely Unfair
f = Extremely Unfair

		Theoretical Combination	Advancement Exam %	Performance Evaluation %	Total Length of Service %	Time in Pay Grade %	Good Conduct Medals %	All other Awards %	Other %	Total Percentage %
3.	a b c d e f	XA	17	17	17	17	16	16	00	100
4.	a b c d e f	XB	30	30	15	15	5	5	00	100
5.	a b c d e f	XC	43	27	11	11	5	3	00	100
6.	a b c d e f	XD	90	4	2	2	1	1	00	100
7.	a b c d e f	XE	30	40	10	10	5	5	00	100

APPENDIX D

Methodology Employed in Computation of Proportionate Influences of Components

APPENDIX D

Methodology Employed in Computation of Proportionate Influences of Components

1. Selection of an appropriate model for determining the proportionate influences of components in a composite has been the subject of theorizing and research for many years. Among others, the issue is nicely discussed by Ghiselli (1964), Darlington (1968), Dunnette & Hoggatt (1957), and Stanley & Wang (1968). The various means of differentially weighting components include the following--expressing the size of each component's:

a. Maximum/minimum score.

b. Multiplier weight of raw score.

c. Standard Deviation.

d. Correlation coefficient-beta weight ($r\beta$) products of regression analysis.

The Navy enlisted advancement system uses a combination of the first and second, as displayed in Table 1. Thus after the components are "weighted" by various multipliers, they are added to form a single composite, the Final Multiple Score (FMS). This final composite is then available as a dependent variable to perform regression analysis.

2. For this analysis, the use of the above first and second methods of representing component weights, and the use of the FMS as the dependent variable, were rejected as not only inappropriate, but quite misleading, for the following reasons:

a. Relative differences in standard deviation (the third of the above enumerated methods) are a much greater influence among components than is the raw multiplier or the maximum/minimum scores. Intercorrelations among the components are another source of influence.

b. Scores in the high/low tail (maximum/minimum score) of a distribution are quite unstable for statistical analysis. There could be a few scores there or a substantial pile-up of scores.

c. Use of the FMS as the dependent variable for regression analysis is particularly misleading because advancements are not selected from the top of the rank-ordered FMS. Instead, advancements are selected after exam-fails (a substantial majority in competition for Pay Grades 6 and 7) are deleted.

3. It is thus important to distinguish between two kinds of weights (Ghiselli, 1964). The nominal weights are those deliberately assigned

to the components--the intended policy weights, frequently expressed simply as a percentage of a maximum score. The effective weights are those which the components actually carry in the composite. The effective and nominal weights may or may not be the same (dependent especially upon the standard deviations and intercorrelations among the components as discussed above), and usually are not the same.

4. The only relevant criterion for a question of proportionate influences in advancement is the fact of advancement itself. Thus the dichotomous criterion of advanced-not advanced was selected as the basis of this study. In its application to regression analysis, the following considerations and adjustments are pertinent:

a. The mathematical model for regression analysis assumes a normal distribution of the dependent variable.

b. The Navy system functions as a "closed" system, i.e., all components are accounted for so that the percentage influences should total 100 percent. In regression analysis this is indicated by:

(1) The coefficient of multiple correlation (R) equaling 1.0, and

(2) The Sum (Σ) of the correlation coefficient-beta weight ($r\beta$) products equaling R^2, in turn equaling 1.0.

c. Use of a dichotomous dependent variable will substantially restrict the coefficient R below 1.0 which requires an adjustment of the $r\beta$ products by an increase proportionate to the increase from the restricted R^2 back to 1.0. The method is illustrated in Table 3. For example, the $r\beta$ product for the Pay Grade 4 exam component is multiplied by 1.46, the amount necessary to increase the R^2 from .685 to 1.0, thereby adjusting the $r\beta$ from .596 to .870; and all adjusted components (.870, .126, .006 and -.002) totaling 1.000.

d. Due to rounding to nearest whole percentage, and distortion from use of a dichotomous variable, obtained total values will vary a few percentage points from 100 percent.

e. Due to the dominance of one component to the total exclusion of another, the excluded component will sometimes assume a negative $r\beta$ value from the effect of a negative correlation with the dominant component. The negative $r\beta$ effect is to be distinguished from the system causing a negative weight (i.e., points are not systematically subtracted from the candidate high on the excluded component).